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ABSTRACT

The Eisenhower National Clearinghouse for Mathematics and Science Education (ENC) helps teachers by offering a broad assortment of services to enable them to quickly locate educational resources. This document is one in a series of print catalogs designed to give educators information about curriculum resources available for teaching math and science in K-12 classrooms. Each issue of ENC Focus presents a selection of the Clearinghouse collection focused on a topic of particular interest to math and science teachers. In addition to meeting general requirements for inclusion in the ENC collection, curriculum materials in the Focus series are appropriate to the specific topic of the issue; support hands-on, active, inquiry-based methods of instruction; and are readily available. This issue offers a sampling of useful informal educational materials and other resources in mathematics and science education. A one-page description of each resource provides an abstract of the contents, subjects addressed, grade level, publication date, ordering information including price, authors, and related resources. (ASK)

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Volume 5, Issue 2,

enc FOCUS

For Mathematics and Science Education

ED 422 191

Informal Mathematics

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Using ENC to learn more about informal math and science education

The Eisenhower National Clearinghouse for Mathematics and Science Education was established to help K–12 teachers locate useful teaching materials. The Clearinghouse collects all types of materials at the National Repository in Columbus, Ohio, at The Ohio State University. ENC makes information available about all of these resources in several ways. For example, this print catalog is one of a series that highlights specific topics and resources in math and science. All of ENC's resources in combination will provide comprehensive information for teachers on a variety of topics, including informal education.

ENC Online

ENC Online has links to exemplary science and math Internet sites through the Digital Dozen, selected monthly, classroom links, and other educational resources. Some Internet sites are available with information about informal math and science education. You can find them in two ways: search Resource Finder, or browse through the links on ENC Online. If you have time to browse, you will find all kinds of things you might be able to use in your classroom. ENC Online also links to many of the resources acquired or developed for ENC's CD-ROMs.

ENC CD-ROMs

ENC's CD-ROMs have a variety of previously published documents in electronic format about curriculum issues in math and science education, as well as resources developed by ENC to meet educators' needs. These documents cover curriculum standards and implementation, and include the complete 1989 NCTM *Curriculum and Evaluation Standards for School Mathematics*. TIMSS (Third International Math and Science Study) and Equity are the topics of the two newest ENC CDs. The content of these discs is available online as well; for the TIMSS materials, go to http://timss.enc.org/, and you can go to http://equity.enc.org/ for the equity resources.

ENC Demonstration Sites

Located throughout the country, these 12 sites can be found at, or work in conjunction with, the 10 Eisenhower Regional Consortia (see inside back cover), at the Capital Collection & Demonstration Site at The George Washington University in Washington, DC, and at ENC. Teachers and other educators can visit or contact the Site in their area for a complete demonstration of ENC's services as well as assistance in locating educational materials and using new technologies. For a directory of the Demo Sites, see pages 55 and 56.

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U. S. Department of Education	***Office of Educational Research and Improvement***	***Office of Reform Assistance and Dissemination***
Richard W. Riley Secretary	C. Kent McGuire Assistant Secretary	Peirce Hammond Director

Cover note: the photographs on the front cover were provided courtesy of the Exploratorium, the Girl Scouts of the U.S.A., and Six Flags Over Texas.

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Past issues of *ENC Focus* include *Integrating Math and Science, New Approaches to Assessment in Science and Mathematics, Calculator-Active Materials, CD-ROMs and Laserdiscs for Science, Professional Development for Math and Science, Using Children's Literature in Math and Science,* and *Multicultural Approaches in Math and Science.*

While some back issues are out of print, most are available online at http://www.enc.org/ or on CD-ROM.

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How to Connect to ENC Online

To connect to ENC Online via the Internet, visit ENC's World Wide Web site (http://www.enc.org/). You can also telnet to guest.enc.org; via modem dial (800) 362-4448 or (614) 292-9040. Set your communication software to VT100 terminal emulation, no parity, 8 data bits, 1 stop bit, and full duplex. Once connected, press <RETURN> to bring up a screen and type c to connect. All the information you need to use ENC Online is on the screen.

ENC Reference Services

People with questions related to K–12 math or science education can call the ENC Resource Center's reference staff. Services include assistance with locating teaching materials, conducting research, and making effective use of ENC Online and Resource Finder, ENC's catalog of curriculum resources. Call the Reference Desk at (800) 621-5785 or dial (614) 292-9734. Questions can also be sent via e-mail to library@enc.org.

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Introduction

It's ironic that today, the day I'm writing this introduction, my daughter is visiting the Center for Science and Industry (COSI) in Columbus, Ohio, with her Brownie troop. More than 400 girls, ages 6 to 8, will descend on the place and spend the day getting involved in both structured and nonstructured activities. My daughter will experience the power of electricity, watch a 60-foot, 200-pound pendulum knock down pins, lift a 1,000-pound car using a lever, and discover just how hard her heart works. Will the experience be like herding cats for the troop leaders? Probably. What will my daughter get out of her visit? Lots of stories and plenty of questions, I'm sure. Her explanations of what she saw will probably not be exactly scientific. So, why is it still important for her to experience COSI and other informal education sites such as zoos and aquariums?

Children are naturally curious and have a sense of wonder. They are constantly asking questions, using their senses to find out more about the world around them. Informal science learning environments such as science centers, museums, and zoos can provide students with unique, engaging, and captivating science experiences and opportunities. Combining formal experiences (schools), informal experiences (zoos, science centers, aquariums, etc.), and nonformal science experiences (4-H programs, Girl and Boy Scouts, etc.) is critical to improving their scientific literacy (Carlson and Maxa, 1997).

© The Exploratorium

The Exploratorium Science Center in San Francisco, California

Informal Education Experts

In this issue of *Focus*, we highlight resources and identify people from different informal and nonformal educational settings. To illustrate the importance of informal education and the impact it can have on children's growth and learning, we interviewed a number of experts, including Jack Hanna from the Columbus Zoo and David Letterman fame; Richard Taylor, a Texas teacher who started bringing his physics classes to Six Flags before it was "the thing" to do; and Ellen Petrick-Underwood, Environmental Education Specialist for Yellowstone National Park. Each of the interviewees were asked questions such as: Why should I, as a teacher or parent, take advantage of the informal educational programs in my area? How can I get my students focused on learning while they are there? What are the long-term benefits of bringing students there? These questions and more are answered in the articles found at the beginning of each section.

Throughout the interviews, many of the same themes kept cropping up, such as the idea that in an informal setting there is nothing "virtual" or "fake" and that the learning is from the tactile and the immediate. Ellen Petrick-Underwood says informal locations such as national parks have the distinct advantage of being able to teach the real thing in the right place. To Richard Taylor, it is incredible to see what happens when he takes his students into the real world and shows them that what they have been doing all year in the classroom really does apply to things they do every day. He knows that the students will go to Six Flags for the rest of their lives, and every time they do from now on, they will think about physics. Jack Hanna says that live experience is the key. For instance, hearing the low rumbling of an elephant or feeling a snake's smooth skin really make a lasting impression on students who come to the zoo.

A second common theme is to make sure that what happens in an informal setting reflects what is going on in the classroom. Valerie Chase from the National Aquarium in Baltimore recommends choosing a field experience to be either a motivator at the beginning of a project, a site from which to collect data or information in the process of a project, or a summative experience at the end of a unit that reinforces what you have been teaching. She says that informal education is even more effective when it supports what goes on in the classroom.

Modeling the behavior of scientists is another theme that runs through many of the interviews, and many programs ask participants to model the types of investigation that scientists do. Dr. Rob Semper, Executive Associate Director of the Exploratorium science center in San Francisco, believes that opportunities of surprise are key educational events at a museum and that parents should be good role models of inquiry. Similarly, Carolyn Kennedy, Director of Special Projects with Girl Scouts of the U.S.A, describes how the National Science Partnership for Science Museums (NSP) encourages participants to work through the processes of science. People are active participants in their own learning and therefore the goal is to give people experience with ask-

ing their own questions and driving their own investigations. Many of the interviewees also describe extensive teacher professional development programs. Programs such as teacher sleepovers, week-long teacher workshops, and orientations are available for teachers. In addition, many museums, zoos, and national parks have volunteers and staff that are willing to make classroom visits.

Real and Virtual Resources

In addition to these articles, this issue of *Focus* highlights resources, both real and virtual, that were developed by each of the different kinds of informal science centers featured in this issue. We specifically chose resources that could be used in classrooms anywhere in the country, even though the topic might be the Everglades or Yellowstone. We have highlighted materials from other national parks such as Acadia National Park in Bar Harbor, Maine, and Fossil Butte National Monument in Kemmerer, Wyoming.

In each of the six sections, we chose Internet sites that provide not only wonderful activities and resources for classroom teachers and parents, but also virtual field trips that can be taken by individual students, families, or entire classrooms. Don't think you will ever make it to Big Bend National Park in West Texas? Visit their Web site to read about the natural history of Big Bend, review the rock cycle, and view images that demonstrate the effects of faulting, folding, and jointing. The site also features a virtual hike along the Lost Mine Trail, located in the Chisos Basin of the park. The hike includes examples of erosion, native plants, and biological weathering as well as additional rock structures. This is just one of many virtual field trips available on the Web. For more information on electronic field trips, check out http://commtechlab.msu.edu/sites/letsnet/NoFrames/BigIdeas/index.html.

We hope you find the resources and information in this issue helpful. The opportunities to enhance and support learning through informal means are enormous and should not be overlooked by any educator—and that includes parents and teachers. For example, can you picture 20 children, tape measures and stopwatches in hand, racing fish that are swimming in a 110-foot long 335,000-gallon aquarium? Or students collecting data from differently shaped fish over multiple trials, figuring out their speed and then determining the relationship between shape and speed? It's definitely better than reading about it in a book.

By the way, my daughter brought home a tadpole from COSI—she named it Spot. He's alive and well and getting bigger all the time. Talk about enormous learning potential!

Kimberly S. Roempler, Ph.D
ENC Content Support

Source

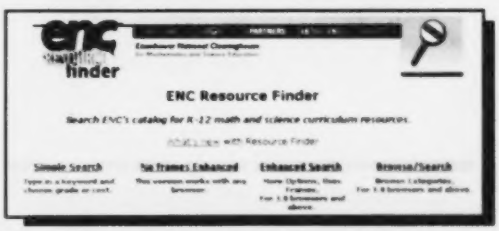
Carlson, Stephan & Maxa, Sue. (1997). *Science Standards for Nonformal Education.* St. Paul, MN: Minnesota Extension Service, University of Minnesota.

Searching
ENC's Collection of Curriculum Resources

You can get to *Resource Finder*, ENC's online database of educational materials, at **http://www.enc.org/**. Four search engines are available for use: *Simple Search*, *No Frames Enhanced*, *Enhanced Search*, and *Browse/Search*.

The *Simple Search* allows you to search using words, as well as grade level and cost. A sample *Simple Search* could include Museums AND Zoos as Search Words, Grade 3, and any cost. The return list includes resources with both "museums" and "zoos" in the catalog records.

The *No Frames Enhanced* search allows you to better limit and define your search. In addition to word search, grade level, and cost, limiters such as Resource Type, Subject, and Standards are available. Lists of ENC's controlled vocabulary are provided. For instance, Resource Type includes words such as Professional Guides and World Wide Web (WWW) resource. A sample search using *No Frames Enhanced* could have National Parks, Endangered Species (if you use more than one subject, the terms need to be separated by a comma) as Subject; 4 as Grade; and Activities as Resource Type. One of the resources in the return list for this search is *Children Are the Future of the Everglades* (ENC-011877) (see page 12).



The *Enhanced Search*, which uses frames, features pop-up vocabulary lists. The *Browse/Search* feature allows you to browse large categories based on ENC's subject lists.

You can also search by ENC number (i.e., ENC-011877), a designation we assign to each resource to indicate where it is shelved in our repository. This number appears at the end of the abstract in *Focus*. You can search for specific records in *Resource Finder* by typing in the ENC number in the Search Words blank. For example, typing in ENC-011586 brings up the record for *Earth Matters: A Challenge for Environmental Action* (1990), published by the Girl Scouts of the U.S.A. (see page 50). When contacting ENC about a particular resource, be sure to refer to the ENC number.

For each item in a return list, an icon lets you know what kind of resource it is (for example, videotape, kit, or Web site). Each icon is followed by descriptive text that contains its title, grade range, cost range, and the beginning of the abstract. Clicking on the title brings up the entire record, including the complete abstract, the table of contents, any evaluations, and availability information.

Web Sites

Informal Science Education: An NSTA Position Statement
http://www.nsta.org/handbook/informaleducation.htm

The National Science Teachers' Association (NSTA) supports the development of sustained links between informal institutions and schools as a means of meeting the goals articulated by the *National Science Education Standards* (1995). The position statement presented on their Web site defines informal education as programs and experiences developed outside the classroom by institutions that include museums, zoos, and botanical gardens, as well as parks, nature centers, and environmental education centers. Other informal education sources are community-based, such as youth organizations and community outreach services. The position statement lists the contributions of informal science education in terms of enhancing science studies, addressing different learning styles, increasing community and parental involvement, and promoting life-long learning. NSTA advocates that local corporations and institutions support informal science education in their communities. [ENC-011940]

Science Standards for Nonformal Education
http://www.cyfernet.org/scistandards.html

The *Science Standards for Nonformal Education* were developed by the Minnesota Extension Service at the University of Minnesota. The standards are designed to help educators and volunteer leaders understand the importance of nurturing the skills necessary for a scientifically literate society. They are compatible with other national science standards efforts, such as *Benchmarks for Science Literacy* and the *National Science Education Standards*, and include sections on scientific inquiry content standards, science and technology, and teaching and learning in nonformal settings. The purpose of these standards is to encourage understanding of science and technology, address standards from a nonformal perspective, and ensure that nonformal standards are compatible with other science standards. The standards recognize that youth with diverse backgrounds, learning styles, and interest levels acquire understanding in varying ways that are appropriate and fun for them. A checklist is provided to evaluate good learning experiences and examples show how good learning and teaching methods can be applied to science. [ENC-011346]

Annotated Bibliography

Barlow, D. (1997). Education to make a life. *The Education Digest*, 63(1), 43–46.
This article describes a week-long trip Barlow took with students and parents to Crow Canyon Archaeological Center in Colorado. He comments on participants' educational experiences and reflects that although most of them won't use what they learned, their lives will be richer because of the time spent in Crow Canyon.

Clemens-Walatka, B. (1998). Amusement park inquiry. *The Science Teacher*, 65(1), 21–23.
The author describes the experience of taking her students on a field trip to an amusement park at the end of the school year.

Confar, P. L. (1995). Field trips worth the effort. *Learning*, 23(6), 34.
This article discusses well-designed, relevant field trips and how they can relate classroom topics to students' lives.

Cullinan, K. (1995). Recharge yourself at a science center! *Science and Children*, 33(3), 41–42.
Cullinan describes how teachers can adapt a science center's educational programs and hands-on activities for their classrooms.

Farmer, A. J. (1995). Field trips and follow-up activities: Fourth graders in a public garden. *The Journal of Environmental Education*, 27(1), 33–35.
In this study, the relationship between learning, field trips, and follow-up activities is examined.

Kongshem, L. (1995). The discoverers: Science museums. *Executive Educator*, 17(11), 17–21.
This article focuses on the Exploratorium in San Francisco, California, a museum that demonstrates how educators can encourage student involvement in science.

Lanier-Morris, D. (1995). Slumber party science: Why my class slept over at the science center and how yours can, too. *Instructor*, 104(6), 50–51.
This article describes a camp-in night at the Maryland Science Center.

Leary, R. (1996). Field trip tips. *Science and Children*, 34(1), 26–29.
This article focuses on the importance of student preparation for field trips.

McCreedy, D., Borun, M., Mosatche, H.S., & Wagner, K.F. (1996). A collaboration for education. *Science and Children*, 34(2), 38–41.
This article discusses museum and community partnerships that encourage family involvement in science.

Power, B. (1997). How to turn field trips into writing adventures. *Instructor*, 106(7), 42–43.
This article provides eight management tips to turn field trips into writing adventures.

Ramey-Gassert, L. (1997). Learning science beyond the classroom. *The Elementary School Journal*, 97(4), 433–50.
The focus in this article is on the importance of informal science learning experiences in a variety of out-of-school science environments for children and for inservice and preservice teachers.

Sussman, B. (1995). Late night at the museum. *Science Scope*, 18(6), 60–62.
Part of a special issue on science in nontraditional settings, this article describes a field trip that involved staying up all night at the Chicago Field Museum of Natural History.

Items Featured in This Issue

Pricing and ordering information were verified in May, 1998, and are subject to change.

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Fascinating Fossil Factory	3–5	$30.00	11
Children Are the Future of the Everglades: A Curriculum for 4th Grade Teachers	4	$34.95	12
Expèdition: Yellowstone!	4–6	$49.95	13
Mojave Desert Discovery	3–6	$7.50	14

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Curriculum Resources

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Test Tube Zoo	6–12	$19.95	18
Temperate Forests: Teacher's Manual	4–6	$59.95	19
Diversity of Lifestyles, Module 1	6–8	$299.95	20
Pablo Python Looks at Animals	K–3	$299.95	20
Wetlands: Ecological Powerhouses	K–4	$5.00	21
The Salamander Room	Pre-K–3	$45.95	22
Imogene's Antlers	Pre-K–3	$45.95	22

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Curriculum Resources

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Seashore Life on Rocky Coasts	7 and up	$9.95	26
Saving Inky	4–6	$13.95	27
Living in Water: An Aquatic Science Curriculum for Grades 5 to 7	5–7	$23.95	28
Sea Searcher's Handbook: Activities from the Monterey Bay Aquarium	Pre-K–8	$16.95	28
Whales: K to 3 Teacher's Guide	K–3	$9.00	29

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Paramount Parks Math Day High School Activity Booklet	9–12	Free	34
Roller Coaster Physics	8–12	$240.00	35
Archibald Frisby	Pre-K–3	$45.95	35

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The Cool Hot Rod and Other Electrifying Experiments on Energy and Matter	6–12	$10.95	38
The Cheshire Cat and Other Eye-Popping Experiments on How We See the World	6–12	$10.95	38
Beyond Numbers: Elementary Guide	4–8	Free	39
Astro Adventures	4–12	$24.95	40
Brain Power: It's All in Your Head	5–8	$9.00	40

* Please see record for details

Web Sites [Section V]

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Curriculum Resources

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Science in the Worlds	4–6	$20.75	47
Outdoor Education in Girl Scouting	K–12	$9.50	48
The Estes Educator Guide for Teachers and Youth Group Leaders	5–12	$2.40	49
Earth Matters: A Challenge for Environmental Action	1–12	$2.50	50
A Patch of Eden: America's Inner-City Gardeners	5 and up	$18.95	50
To Build a Trail: Enhancing America's Pathways	7–12	$5.00	51
Recreational Trails	5–9	$1.25	51
Mud, Muck, and Other Wonderful Things	K–3	$6.00	52
Outer Spaces: Discovering the Explorer in Me	5–10	$7.50	52
Financial Fitness	7–12	$8.00	53
What's Equal? Figuring out What Works for Girls in Coed Settings	Pre-K–12	$15.00	54
Questions	1–12	$20.00	54

* Please see record for details

Section 1: National Parks

Learning the Natural Way:
Interviews with Chip Littlefield and Ellen Petrick-Underwood

Julia L. Harris
ENC Publishing Group

As a child, I went on many camping trips with my family, and I remember well the times we spent looking for arrowheads, carving figures out of soapstone, building shelters from fallen branches . . . We saw an occasional fox, several deer and squirrels, and one thrilling time in Yosemite, we even saw a bear. The adventures I had meandering in the woods gave me a lifelong appreciation for nature and an interest in conservation—and a healthy respect for poison oak.

Because of my own background, I know what a valuable resource we possess in our National Parks, and how significant their influence can be in a young person's educational and personal development. I spoke with two people who work for the National Park system—Chip Littlefield, a long-time park ranger at Saguaro National Park in Arizona, and Ellen Petrick-Underwood, Environmental Education Specialist at Yellowstone in Wyoming—and they agree that time spent in nature can have an impact that lasts long after the visit itself has faded from memory.

Chip Littlefield:
Cultivating Stewards of Nature

For 15 years, Chip Littlefield has been working to build an awareness of nature and a sense of responsibility in the children and adults he works with at Saguaro National Park. The zeal he brings to his work can perhaps be traced to his own upbringing near Maine's Acadia National Park, one of the most heavily visited parks in the country. "I didn't have any idea of the significance and beauty of this National Park and what it meant," he says. "So I think it's important to reach kids early on and give them a vested interest in preserving our wilderness areas. They need to realize that they are the stewards; I'm just the custodian."

Littlefield works with a cadre of volunteers, made up of former teachers, principals, and school superintendents, to make sure that a visit to the park is more than just a fun field trip for the children. Park staff regularly make pre-visit presentations to classrooms to prepare students for what they will see and do on their trip. During these presentations, children are told what they will need to wear and bring with them, what kinds of behavior are expected of them while in the park, and what kinds of things they'll be learning. The purpose of the pre-visit, Littlefield says, is to give students a kind of road map that explains expectations and outlines parameters, thereby reducing the level of uncertainty students feel.

Extending the Classroom

© Vera Kuklova

A desert landscape peopled with Saguaro cacti.

A key component of a successful experience at a park or wilderness area is to make sure the educational programs are curriculum based and support what is happening in the classroom. Saguaro provides environmental education resources for educators that include a teacher's guide, sent out in advance of the visit to the park, and additional activities that can be completed in the classroom once the visit is over. Coupled with a hands-on, interactive excursion in the park, these materials provide a comprehensive approach to the environment, which Littlefield sees as crucial. "The program might be fun and enjoyable, and the kids get to be outside, but if it doesn't support what they are learning in the classroom, then you're missing the mark," he explains.

While at the park, students work in small groups and progress through four "stations"—storage, food, shelter, and communication—where they learn about the interrelationships among desert plants and animals. At the storage station, children learn about how the Indians stored things and experiment with making pottery from clay. The communication station is another favorite with participants, because they are encouraged to examine and draw the petroglyphs that were etched into the rocks by Indians more than a thousand years ago. "It's a good hands-on program and we try to involve the children as much as we can," Littlefield says. "We stress that there are no wrong answers—if something comes up that is not quite accurate, we just work it into a more correct context."

In addition to its environmental education programs, the park offers a Junior Ranger program geared primarily for grades 5–12—although Littlefield says the range of participants can be

quite diverse: "I've seen 4-year-olds go through with their parents writing the answers for them, and once we had a 60-year-old person do it." The program is informal enough so that people can simply go into the visitor center, sign out a backpack full of materials, and walk through the program on their own. Saguaro also offers a one-day summer camp and a more comprehensive version of the Junior Ranger program, called Cactus Rangers.

Teaching the Teachers

Children aren't the only ones who can benefit from the resources at Saguaro. Twice per year, Littlefield and his colleagues offer workshops that are designed to stimulate teacher interest and enthusiasm about nature. Participants are taken through the same program as the children, getting a chance to make their own clay pots and petroglyphs, even going on night walks through the desert. "We try to keep it fun," Littlefield says. "We know that teachers are moms and dads, they are busy with things to do after school, so we try to keep them moving instead of making them sit through a lecture and get a credit for it." The hands-on approach works with teachers as well as it does with children, and the workshops have helped get teachers excited about the learning possibilities at the park.

Littlefield cannot stress enough the importance of an interactive experience with nature. "I think there needs to be a more holistic approach to education—it doesn't just happen in the schools, and it's not just about abc's," he insists. "It happens in the home and in field events and opportunities to get outside the classroom, whether you go to state parks, county parks, national parks, even your local park. The resources are all around us; we just need to get out and slow down a little bit and smell, touch, feel. That's what it's all about."

Ellen Petrick-Underwood:
Staying Power

Littlefield's sentiment is shared by Ellen Petrick-Underwood, Environmental Education Specialist at Yellowstone National Park. "In parks we have the distinct advantage of being able to teach the real thing in the right place," she says. "There is nothing virtual or false, and we're not teaching primarily from books but from the tactile and the immediate. That tends to stay with people."

A Yellowstone geyser in action.

Petrick-Underwood has been at Yellowstone for four years now; before coming on full time, she spent nine summers living and working in the park. Her long-standing relationship with the park has helped deepen her appreciation for the work that goes on there. And Yellowstone is unique, not just because it is the world's first National Park. Set aside for posterity by an Act of Congress in 1872, its 2.2 million acres contain half of the world's known geothermal features, including more than 300 geysers. The world's tallest geyser, Steamboat, can be found here; when active, its eruptions can reach heights of more than 380 feet. Yellowstone also protects several federally listed endangered species, such as the gray wolf, the whooping crane, and the peregrine falcon. Wolves were reintroduced into the wild at Yellowstone in 1995, and have proven to be a big draw for the more than 3 million annual visitors. Yellowstone is also responsible for rescuing from extinction the last remnant of the once-vast bison herds of the Great Plains.

Wolves are now a common sight.

The park has an impressive pedigree, and Petrick-Underwood is committed to providing quality education programs that showcase the resources it has to offer. One of these programs is "Expedition Yellowstone," which has been in existence since 1985 and is targeted for students in grades four through six. The program is curriculum-based and can be done in either a classroom setting or in conjunction with an extended stay in the park. Based at the Lamar Buffalo Ranch, the historic site where the bison were brought back at the turn of the century, the program is taught by a seasonal staff of park rangers with extensive and varied experience in environmental education. The goal of "Expedition Yellowstone" is to teach the natural and cultural history of the park, investigate current issues affecting the Yellowstone ecosystem, and promote preservation in both school and home communities. "It's a field-based program," says Petrick-Underwood. "We focus on park geology, plants, animals, and human history. A lot of learning occurs through hiking."

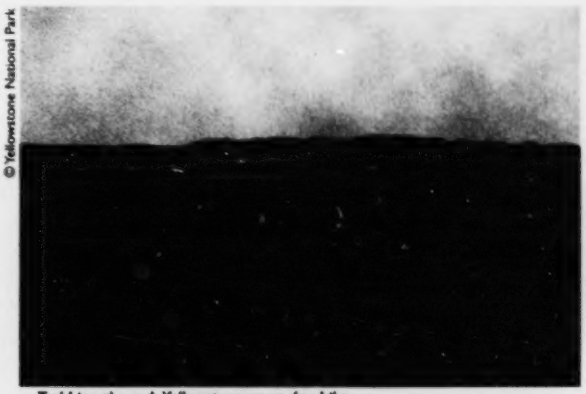
As at Saguaro National Park, Yellowstone also runs a popular Junior Ranger program, which serves more than 11,000 students each year. Offered during the summer months, the program encourages students to participate with their parents to earn the Junior Ranger badge. "The goal is to provide families with a broader understanding of park resources, as well as their own responsibility toward them," Petrick-Underwood explains.

For local students, the park hosts a summer day camp program called "Exploring Yellowstone," which introduces school-age kids to skills that will enable them to more fully appreciate and responsibly enjoy Yellowstone. With a focus on outdoor activities, the program offers classes such as fly fishing and drawing from nature. Another program for surrounding schools is "Earth Day Yellowstone Educational Fair," where students spend a day learning about Yellowstone and the importance of preservation through a variety of fun and educational activities. In addition, lectures, field trips, and school programs both in the park and community are offered on a request basis, and the environmental education office responds to many informational requests from students and teachers each year on a wide variety of topics.

Hands-on Yellowstone

The opportunity to visit the park and experience its resources first-hand simply cannot be duplicated through any other means, says Petrick-Underwood. "There are some excellent CD-ROMs, books, videos, and teaching kits available, but a visit to the park is an invaluable experience," she stresses. "The students are not reading about the geological process—they're going out and hiking it, seeing petrified trees, geysers, hot springs, wild rivers and lakes. . . They are living it as they are learning about it."

As students encounter these phenomena, they have the opportunity to explore the geology more fully and ask questions such as why there are geysers in Yellowstone and not elsewhere, and how they work. To help students process some of what they are learning, Yellowstone staff ask them to keep journals in which they can record their observations and answer some guided questions about the specific environments they have experienced. Another way to extend students' learning experience is to encourage them to talk about it with their parents; Petrick-Underwood recommends that children take their family back to Yellowstone and lead them through the same program. The child then becomes the expert for the family and gets the opportunity to demonstrate what he or she has learned.



Trekking through Yellowstone on a day hike.

For Petrick-Underwood, the most rewarding aspect of her work is the opportunity to provide park visitors with an educational, fun, and memorable experience that will stay with them long after their visit. "Our parks are national treasures and should be a part of every American's sense of identity," she says. "For students who go through these programs, it really is a once-in-a-lifetime experience. . . the possibilities really are endless, and the experiences are priceless."

National Parks Mystery #1 Brings Intrigue to Yellowstone

Annette Thorson
ENC Publishing Group

Teachers and parents favor books that educate—youngsters crave books that exhilarate. The answer? National Geographic's new *National Parks Mysteries*, a series that combines fast-paced adventure with a scientifically accurate portrayal of natural phenomena in America's national parks.

Wolf Stalker [ENC-011618], the first novel in the series, has just been released. Set in Yellowstone National Park, it is the first work of fiction ever published in the 110-year history of the National Geographic Society. According to Barbara Lalicki, director of children's publishing for National Geographic, her division wanted to reach out to young readers who might not be attracted to a strictly factual presentation.

To blend the best of the nonfiction and fiction genres requires the collaboration of two writers: Gloria Skurzynski, author of 38 award-winning children's books—many of them in the field of science—and Alane Ferguson, children's mystery writer who has won the Edgar Award from the Mystery Writers of America. In *Wolf Stalker*, the mother-daughter team combines talents to present the wolf-restoration project and the Yellowstone environment in a story of teenage rebellion that will appeal to middle school readers.

One of Skurzynski's goals was that readers could go to Yellowstone and retrace the path of the three young characters, experiencing for themselves the environment described in the book. Skurzynski herself walked each step of the way, taking notes and color photos, some of which are published in *Wolf Stalker* along with pictures from the National Geographic photographers.

Skurzynski is exacting in her approach to researching her science books partly because she loves science and partly because she respects children and knows they will be quick to notice inaccuracies. This combination of scientific rigor and understanding of young readers has brought Skurzynski's work the respect of scientists and science educators.

Books by Skurzynski include *Almost the Real Thing* (Bradbury, 1991), winner of the 1992 Children's Science Book Award from the American Institute of Physics. *Zero Gravity* (Bradbury, 1994) was named a National Science Teachers Association / Children's Book Council Outstanding Science Trade Book for Children for 1995 and a Children's Book of the Year by the Bank Street College Child Study Committee. Visit **http://redhawknorth.com/gloria** for more information about Skurzynski's other nonfiction science books and novels with a scientific twist.

Fans of *Wolf Stalker* will be pleased to know that Skurzynski and Ferguson are collaborating on the next *National Parks Mystery*, which is set in Hawaii Volcanoes National Park. The third book in the series will feature Mesa Verde National Park and the fourth will be set in either Denali or the Everglades. Skurzynski notes that National Geographic is interested in expanding the series to cover the rest of the national parks—all 50 of them!

Curriculum Resources

Grades 2, 3

Teaching Paleontology in the National Parks and Monuments and Public Lands

1995

Series: Parks as Classrooms

Publisher

Fossil Butte National Monument
National Park Service
Orders
PO Box 592
Kemmerer, WY 83101-0592
Telephone: (307) 877-4455
Fax: (307) 877-4457
http://www.nps.gov/fobu/

1 kit (notebook and other print materials): ***Free***

Author

Project coordinated by Marcia Fagnant; developed by Michael B. Leite and Brent H. Breithaupt

Standards

Idaho K–12 Science Content Guide and Framework (1994); Utah Elementary Core Curriculum Standards, science, levels K–6 (1994); Wyoming Science and Mathematics (1994)

Part of the *Parks as Classrooms* program developed by Fossil Butte National Monument, this fossil education curriculum guide is designed to aid teachers in presenting the concepts of time, past life, and fossils to their students. The curriculum includes four units that are organized into grade-specific lesson plans: fossilization and human influences for grade 2; and adaptation, community, and human influences for grade 3. All units have fossil themes and complement state science curricula for Wyoming, Idaho, and Utah. Each unit begins with an introduction, followed by a vocabulary list, a reference list, and background information. Also included are field trip ideas, pre- and post-visit activities, and reproducible student handouts. The activities are designed for use in the field and in the classroom. In one sample activity, students examine fossil casts with a magnifier and discuss the evolution of jaws and other adaptations for herbivores and carnivores. For another activity, students play a game similar to freeze tag, in which they role-play different animals and plants that become frozen as fossils when the teacher calls "Freeze!" This guide is part of a travelling kit that includes casts of fossils from different geologic times, an interactive computer program on population dynamics, and two slide programs that introduce fossils, environments, and adaptations. Also included in the kit are posters, maps, plaster, and modeling clay. The kits are available free for check out, and users are responsible for return shipping. Additional kits are available for grades 4–6 and 7–12. (Author/LCT) [ENC-011600]

Grades 3–5

Fascinating Fossil Factory

1994

Distributor

Petrified Forest Museum Association
PO Box 2277
Petrified Forest, AZ 86028
Telephone: (520) 524-6228 ext. 239

1 teacher's guide: ***$30.00***
Note: Add $5.00 for shipping and handling

Author

Faith Caffey and Paula Hosking; illustrations, Hugh Brown

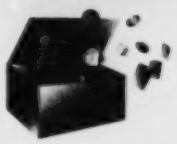
Funding

Petrified Forest Museum Association; Parks as Classrooms

The Petrified Forest National Park developed this curriculum module with a focus on paleontology and geology. The module involves multiple skills, such as teamwork and critical thinking, reading and writing, and basic mathematics and analytic skills. It is designed to facilitate the process of discovery and learning before, during, and after a field trip to the Petrified Forest. Information is given about the park, along with suggestions for planning a visit, pre- and post-visit activities for students, and additional resources. In a sample activity, students prepare a layered gelatin and fruit dessert to demonstrate how layers of rock build up on one another and how fossils become buried between the layers of rock strata. Another activity engages students in using X,Y coordinates to create a copy of one of the Petrified Forest's Triassic inhabitants. For each activity, the book provides background information, summarizes learning objectives, and lists materials required. It also provides activity procedures, extension activities, and reproducible student worksheets. A glossary and bibliographic references are also included. (Author/LCT) [ENC-011508]

Children Are the Future of the Everglades: A Curriculum for 4th Grade Teachers

Grade 4



1998

Distributor

Florida National Parks & Monuments Association Inc.
10 Parachute Key #51
Homestead, FL 33034-6735
Telephone: (305) 247-1216
Fax: (305) 247-1225

1 kit with guide and video: **$34.95**
Note: Plus $4.50 for shipping. Call if ordering bulk quantities. Schools receive 10% discount.

Author

Prepared by Everglades National Park

Standards

Science for All Students (SFAS): the Florida Pre-K–12 Science Curriculum Framework (1993)

Teachers and students throughout Florida can use this curriculum kit's lessons and activities to learn more about the Everglades National Park, even if they never have the opportunity to visit there. The curriculum package contains a video entitled *Adventures in the Everglades*, a curriculum guide, and materials and supplies for classroom activities. The curriculum kit is organized into three units, and each unit includes a video component and three hands-on activities. Unit one, "The Park Story," introduces students to the National Park Service and the Everglades ecosystem. Unit two, "It's All About Water," focuses on the vital issue of water in the Everglades and south Florida. In a sample activity, students use a wet sponge to represent the water-bearing limestone underlying the Everglades. As they take turns squeezing water from the sponge, they also identify the various groups competing for Everglades water. Unit three, "Depending on Each Other," helps students compare basic food chains and webs, recognize adaptations among organisms, and summarize the problems that cause organisms to decline. The video includes a teacher's section that provides an overview of the program and its activities. The curriculum guide provides instructional procedures, background information, and lists of materials needed for each activity. The appendices include reproducible handouts, fun facts, supplementary materials, and assessment tools. (Author/LCT) [ENC-011877]

Related Resources

ENC has other items in its collection related to the Everglades, including:

The Everglades (1990)
Written for grades 3–6, this book describes the plant and animal life found in the Everglades National Park. Readers join students on a field trip through the park that includes the Anahinga Trail, the Gumbo Limbo Trail, and Long Pine Key. As the text describes each of the park's ecosystems, color photographs provide close-up views of the resident birds, animals, insects, and wildflowers. Sample photographs depict an anahinga drying its wings, a great blue heron catching a fish, and a rare purple gallinule. [ENC-011855] Troll Associates, toll-free: (800) 526-5289 **$3.95**

An Activity Guide for Teachers: Everglades National Park (1993)
This activity guide, designed by teachers and park staff, introduces students in grades 4–6 to Florida's Everglades National Park. It features 37 activities that highlight the components of the Everglades ecosystem and how human activities affect the environment. Each activity contains needed background information, suggested procedures, evaluation questions or activities, and extension activities. Appendices include information on the park, drawings of plants and wildlife, and songs relating to the Everglades. Also included are vocabulary lists and a bibliography. [ENC-001076] (See above for contact information.) **$14.95**

Expedition: Yellowstone!

Grades 4–6

1987

Distributor

Yellowstone Association for Natural Science, History, and Education, Inc.
PO Box 117
Yellowstone National Park, WY 82190
Telephone: (307) 344-2293

1 student storybook and teacher's guide: **$49.95**

Author

Written by Jack de Golia and Joe Zarki, with Laura M. Johnston and Sandra C. Robinson; illustrated by Ellen Meloy

The course of study in this workbook, designed to acquaint upper elementary students with Yellowstone National Park, can be done in the classroom or on a field trip to the park. Divided into thematic chapters, it integrates the storybook *Expedition Yellowstone: A Mountain Adventure* with the geology, life science, and social science of the park. Each chapter contains information, vocabulary, and discussion questions related to the story, and some chapters are divided into units for more detailed study of aspects of the chapter theme. For example, the "Man and Yellowstone" chapter is divided into three units that cover the native people, trappers, and explorers of Yellowstone. In a sample activity, students analyze the origins of the foods they eat and compare them with the origins of foods eaten by the Indians in Yellowstone National Park. They also plan menus for their group and calculate the quantity and cost of the food required for their trip. In other units, the students create a calendar of pictures showing what a bear does each month of its life; write a story or play describing the life cycle of an animal in Yellowstone; and build a model of clay mountains and use them to make a topographic map. For each activity, the workbook provides learning objectives, materials, and procedures, as well as extension activities, reproducible student pages, and suggested evaluations. Bibliographic references are also provided. (Author/LCT) [ENC-011506]

Related Resources

ENC has other materials in its collection that talk about Yellowstone, such as:

Natural History of Yellowstone: A CD-ROM Guidebook (1997)

This CD-ROM and accompanying teacher's guide, developed for grades 6–8 as part of the *Zoo Guides* series, introduce the nature of Yellowstone Park and the Greater Yellowstone Ecosystem (GYE). The introductory sections describe Yellowstone's geology and ecology, its climate and seasons, and the impact of humans on it. Additional sections provide a virtual tour of Yellowstone scenery and describe its plants and animals. The teacher's guide offers suggestions and activities for incorporating the CD-ROM into life science and biology courses. Each activity lists the topic covered, the sources of information that it will use, required materials, and a description of the activity, as well as discussion questions for assessment. Internet addresses are also provided. (Author/LCT) [ENC-011305] REMedia Inc., toll-free: (800) 573-6334 **$39.95**

Getting to Know Wildland Fire (1990)

Yellowstone staff developed this teacher's guide to introduce fire ecology to students in grades 4–6. The guide contains eight activities, such as a game in which students play the roles of trees and fire fighters in the face of an advancing fire. Students may also study cross sections of trees to determine the effects of fires, drought, crowding, and beetle infestation. For each activity, the guide summarizes learning objectives, integrated subjects, and background information and also provides materials lists, directions, extension activities, and suggested assessments. (Author/LCT) [ENC-11504] NPS Environmental Education, telephone: (307) 344-2253 **$3.50**

Mojave Desert Discovery

Grades 3–6

1994

Distributor

Joshua Tree National Park Association
74485 National Park Drive
Twentynine Palms, CA 92277
Telephone: (760) 367-1488

1 educator's guide: **$7.50**
Note: Quantities limited.

Author

National Park Service

Funding

National Park Foundation

This educator's guide highlights the cultural and natural history of the areas around and within the Mojave Desert, including Death Valley National Park, Joshua Tree National Park, and Lake Mead National Recreation Area. Other areas covered in the guide include Mojave National Preserve and Red Rock Canyon National Conservation Area. The guide is divided into sections that include deserts and safety, water and geology, and plants and animals, as well as indigenous peoples and westward expansion. Each unit provides background information, a glossary, fun facts, activities, and reproducible student pages. In sample activities, students make a timeline for major events in the history of the Earth and model the effects of habitat destruction by playing a game of musical chairs in which the chairs represent habitats. Another activity lets students create their own animal with adaptations for living in a riparian area. A listing of additional resources is also included. (Author/LCT) [ENC-011540]

Related Resources

ENC has a number of other resources related to national parks, including:

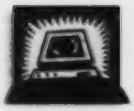
Activity Guide to Acadia National Park (1995)

Staff of Acadia National Park, located on the coast of Maine, developed this activity guide to showcase the park's environmental education opportunities. Intended for grades 3–6, the guide contains three field trip plans that highlight its tide pools, wildlife habitats, and geology. Each plan provides an introductory note for teachers and guidelines for planning the field trip, including a list of things to bring and the locations of picnic areas and restrooms. Also included are activities to do in the park and a simple field guide. The appendices provide bibliographic references and summarize the natural and cultural history of the park. Also provided is general information about park hours, camping facilities, and safety regulations. [ENC-011596] Eastern National Bookstore, telephone: (207) 288-4988 **$6.25**

Where the River Begins: An Educator's Guide to the Nisqually River of Mount Rainier National Park (1994)

Developed for teachers of upper elementary grades, this interdisciplinary guide focuses on the headwaters of the Nisqually River, as well as on old growth forests, glacial rivers, and glaciers. Pre-trip materials comprise teacher lesson plans, including background information and student worksheets that address each of the guide's educational concepts. Onsite activities contain background information for the teacher, lesson plans, and the student log book. Post-trip activities include the following information: subjects covered, process skills, new vocabulary, and learner outcomes. Additional resources include a glossary of special terminology, a bibliography of related educational material, and supplementary Mount Rainier background information. Maps of the Nisqually Glacier and Mount Rainier are also included. [ENC-001433] Mount Rainier National Park, telephone: (360) 569-2211 ext. 3312 **$10.00**

World Wide Web Sites
National Parks



ParkNet
http://www.nps.gov/

The National Park Service (NPS) maintains this Web site to provide information about all the national parks in the United States. On the Web site, sample activities include exploring fire adaptations and learning about endangered species. One section offers pictures of items held in museum collections throughout the NPS, such as fossilized dinosaur bones and George Washington's inaugural coat. An online geology tour of the parks includes features such as caves, glaciers, and fossils. Students can e-mail park historians with their history questions. Two online exhibits include historic photos and text about the use of roads in the NPS and information about the ancient peoples from along the Mississippi River. The site also features a glossary of archeology terms and lists of recommended resources. [ENC-011498]

National Park Foundation
http://www.nationalparks.org/index.htm

The National Park Foundation (NPF) Web site offers general information about the NPF and the national parks, such as financial information and NPF programs that support the parks. It also offers a searchable directory of national parks to help users locate parks by name, state, or region, as well as by special interest or type, such as park, preserve, monument, or historical. Articles from the NPF's newsletter, *The National Park Forum*, can be accessed online. [ENC-011541]

Glacier National Park Electronic Field Trip
http://www.sd5.k12.mt.us/glaciereft/

Students are invited to embark on an electronic field trip to Montana's Glacier National Park through photographs and text that describe the features of the park. Users can also download curriculum materials about the park's ecosystems and wildlife, botany and geology, and glaciers and weather. Sample activities have students build a model of the food chain and investigate an ecological mystery, for which they will use problem-solving skills and some resource books. [ENC-011588]

Big Bend National Park
http://geoweb.tamu.edu/faculty/herbert/bigbend/

Two students from Texas A&M University visited Big Bend National Park to research its geology and take pictures of pertinent geologic features. The data and pictures collected during their trip were used to develop this Web site. Visitors can read about the natural history of Big Bend, review the rock cycle, and view images that demonstrate the effects of faulting, folding, and jointing. Another feature of the site is a virtual hike along the Lost Mine Trail, located in the Chisos Basin of the park. [ENC-008731]

Mammoth Cave National Park
http://www.nps.gov/maca/macahome.htm

Suitable for all ages, this Web site provides information on the history, geology, and activities at Mammoth Cave National Park in Kentucky. A descriptive tour of the cave is given from the perspective of visitors in the 1800s, and a geologic tour provides information on topics such as archaeology, endangered species, and reptiles and amphibians. A complete list of cave tours with routes, costs, and geological formations is given. Special tours involving off-trail spelunking are described, along with a presentation of safety factors and hazards. Programs are offered in the spring and fall that draw attention to the history and heritage of the region as well as the natural wonders of the area surrounding the cave. The site lists activities designed for those with disabilities and for younger people. Links are provided to other National Park sites and to sites dealing with activities in the state of Kentucky. [ENC-011595]

YellowstoneScience.com
http://www.yellowstonescience.com/

Educators, researchers, and the interested public can access this site for information on the science of the Greater Yellowstone Park area. The home page provides access to online articles and photographic images relating to Yellowstone National Park's weather, animal life, geysers, seismology, and volcanology. Additional topics include glaciers, fossil forests, and paleontology. Links to other environmental sites are provided. [ENC-08887]

International Wolf Center Home Page
http://www.wolf.org/

This site, developed by the International Wolf Center in Superior National Forest, Minnesota, seeks to advance wolf conservation efforts by helping people learn to understand and respect wolves. The "Wolf Center News" section contains news releases about the Gray Wolf Restoration Project in Yellowstone National Park. The information in "Telemetry Data" allows classroom teachers and students to use data submitted by collars worn by the wolves to track the movements of the animals. In "Wolf Images," diagrams and photos depict wolves and wolf researchers at work in the field. The teacher's guide contains material for a unit on the Eastern Timber wolf: objectives, concepts, handouts, and tests consisting of multiple choice and fill-in-the-blank questions. Sample activities highlighted on the site include drawing or describing wolves and using wolf communication in the classroom. Vocabulary and bibliographic references are also provided. [ENC-002411]

Section II: Zoos

The Learning Never Stops:

Interview with Jack Hanna

Julia L. Harris
ENC Publishing Group

Jack Hanna has become somewhat of a household name. Children all across the country tune in to watch his escapades in the syndicated weekly television show Jack Hanna's Animal Adventures; *night owls stay up late to watch him swap jokes and show off exotic animals with David Letterman; visitors to the Columbus Zoo and other animal parks laugh and learn as he teaches them about animals and the importance of conservation. His Web site (http://www.jackhanna.com) proclaims, Jack Hanna is "every person's television zoologist."*

Hanna's national celebrity gives him the unique ability to bring his message of animal and wildlife conservation to a broad segment of the population. He uses his frequent guest appearances on shows such as Good Morning America and Larry King Live, as well his many onsite visits to places such as Sea World of Texas, to share his enthusiasm for wildlife with a large and growing audience of both children and adults. "I'd rather entertain and hope that people learn, than teach and hope that people are entertained," he says.

Clearly, Jack Hanna is more than just an entertainer. Director Emeritus of the Columbus Zoo in Ohio since 1993, he is still very involved with zoos and is a member of several conservation societies and professional associations, such as the National Alliance for Species Survival, the American Zoo & Aquarium Association, and the Explorer's Club. Since coming to the Columbus Zoo in 1978, Hanna has worked with his staff to create a program that is both entertaining and educational, one that encourages students to become actively involved in learning about and preserving nature. He finds that a visit to the zoo, especially during a child's early years, provides an opportunity to experience nature and to learn about the animals in a way that cannot be accomplished through books or other media. "The world is the true classroom," he explains. "The most rewarding and important type of learning is through experience, seeing something with our own eyes. A visit to the local zoo, museum, nature center, factory, or even a business will probably stay in the student's mind far longer than if he or she were to study about it in a book."

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Jack Hanna with a baby elephant in Africa.

A Living Classroom

The visiting of zoos, Hanna notes, is the largest family recreation activity in the United States. Last year, more than 125 million people visited the country's 160 zoos; at the Columbus Zoo alone, at least 150,000 children came through for a visit during May, which is the month many schools choose for making field trips. The appeal for families—and for schools—lies in the fact that a trip to the zoo is both fun and educational: "A zoo is much more than a home for animals," Hanna says. "It's a living classroom."

In this living classroom, the excitement that children bring involves them in learning that is multisensory and multifaceted, so that they gain a deeper appreciation for and understanding of what life is all about. Students can actually hear the low rumblings of an elephant or touch a snake's smooth skin; they can look at the bones and teeth of a tiger and see how big they really are. "You can't see this in books; you can't get the atmosphere from a CD-ROM," Hanna stresses. An example he cites is that even though a child may read about how tall a giraffe is and how it has the same number of vertebrae—seven—in its neck as a human being, the knowledge becomes much more real to that child when he or she actually sees a giraffe and realizes just how long that neck really is. Similarly, reading about the 40,000 muscles in an elephant's trunk isn't nearly as memorable as witnessing the versatility afforded by those muscles as the elephant picks up items as small as a kernel of corn or as giant as a one-ton log.

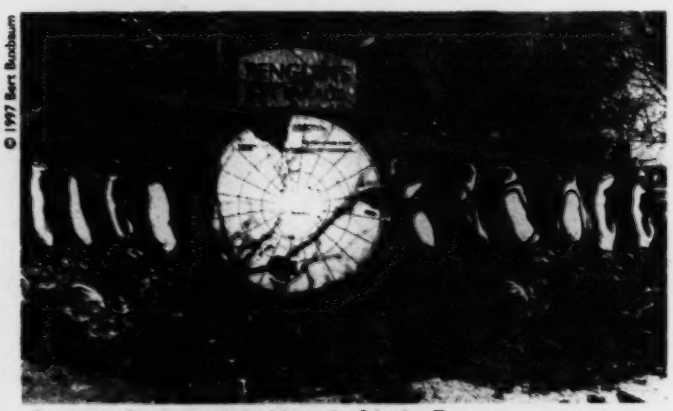
Focus on Learning

Even though reading books and viewing CD-ROMs can't replace the real-life learning that goes on at the zoo, they can be used successfully in classrooms to prepare students for their visit. Hanna suggests that teachers have their students read up on whatever topic they are going to study, look on the Internet for information to supplement more conventional resources, and then write reports or essays that they can review and revise when they return to the classroom after

their visit to the zoo. It is also a good idea to focus on one or two main learning topics—such as a particular group of animals or a specific adaptation, like defense mechanisms—and go over what students should look for while at the zoo. Focusing on specific learning objectives gives students clear parameters and more definite expectations. Subsequent visits can target different exhibits or topics, so that the learning process can be ongoing. "Every time children come to the zoo, they appreciate living things and learn something new about animals," Hanna says. This applies even to himself: after 26 years, he says he still learns something new about animals every time he goes into the zoo or on safari.

Teachers should not forget some of the more practical considerations involved with a field trip to the zoo, such as stressing the types of behavior that will be expected of students while there. An important step in readying them is to make clear that they will be entering the animals' homes and need to treat them with respect—the same kind of respect they would expect of visitors to their own homes. Students should also be oriented as to the layout of the zoo: where the restrooms are, where the first-aid station is, and where to meet for lunch. A map of the zoo would help them get their bearings.

Many zoos offer scheduled events and exhibits that teachers and parents should be aware of before taking their children on a visit. For instance, during the summer the zoo keepers will often give lectures about specific animals, such as the elephants or gorillas. Children also enjoy watching the animals eat, so finding out when feeding times are helps them learn a good deal about the animals' feeding habits. Most zoos offer special programs, such as bird shows, especially during the spring and summer months. Hanna suggests that teachers contact their local zoo prior to their visit and ask for information on special and permanent exhibits, schedules, and pre-visit materials to review with their students.



© 1997 Bert Buxbaum

Penguins on Parade, a special exhibit at the Columbus Zoo.

Lessons for a Lifetime

Animals and nature aren't the only subjects in the "curriculum" taught by a zoo: "As children get older, they learn that the zoo is part of their community," Hanna explains. "They learn about volunteering—half of our zoo is supported by volunteers." Visitors can also explore the variety of career choices available at a thriving zoo—contrary to popular belief, not everyone who works at the zoo is involved with animal care! There are almost 20 different careers operating in a zoo, in such fields as public relations, education, marketing, waste water treatment, landscaping, graphic design, and construction.

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Secretary Richard Riley mentors hands-on learning practices.

As children continue to make visits to the zoo and learn more about animals and conservation, Hanna notes, they become more aware of the interconnectedness and the interdependency of life. His goal is to make them aware of the importance of preserving that life, and the only way to do that is through education. He gives the example of the African elephant: in 1975 there were 1.4 million of them in the wild, and now there are less than 40,000. "The most important thing is to preserve the world we live in," he says. "Unless people understand and learn about our world, habitats, and animals, they won't understand that if we don't protect those habitats, we'll eventually destroy ourselves."

Test Tube Zoo

Grades 6–12

1991

Series: New Explorers: Animals and Their Environment

Publisher

A&E Home Video
PO BOX 2284
South Burlington, VT 05407
Toll-free: (800) 625-9000
Fax: (802) 864-9846
E-mail: homevideo@aetv.com
http://www.aetv.com/index2.html

1 videotape with teaching guide: Order # AH13030
$19.95

Author

Kurtis Productions Inc.; WTTW, Chicago

Funding

Amoco Corporation; United States Department of Energy (USDOE); Waste Management, Inc.

Developed for broadcast on PBS, this series of videos focuses on the research of several new explorers who are on the cutting edge of scientific discovery, extending the frontiers of science, nature, and environmental conservation. The goal of the series is to introduce students to science as a career possibility for their own lives. Each episode includes a teacher's guide with hands-on activities that can be done in the classroom or on a structured field trip; these activities give students experiences that parallel or complement those of the scientists in the video. In this episode, Dr. Betsy Dresser of the Cincinnati Zoo explains how the latest methods in human reproductive technology are helping save endangered animal species. Dr. Dresser combines sperm from a rare male leopard cat with an egg from a female leopard cat to create a test tube embryo. The embryo is then transplanted into a domestic cat that becomes the surrogate mother. The teacher's guide, developed for grades 6–12, contains activities that ask students to examine the role of modern zoos in helping save endangered species. This guide provides an interdisciplinary approach to teaching science that includes history, art, and social studies. While students explore the methods of zoo biology, they are asked to synthesize and evaluate information and then to prioritize and make decisions concerning real situations affecting wildlife today. (Author/KSR) [ENC-00985]

Related Resources

The Last Chance (1979)
The recipient of numerous awards, this video for grade 7 and up explores programs that protect and preserve endangered species. The film profiles two zoos in Washington, D.C.: the Front Royal Zoo and The National Zoological Park Research and Conservation Center's scientific breeding ground for animals. Research teams study the behavior, sociology, and communication of animals such as the Pere David deer, the scimitar horned oryx, and the lesser panda as they breed in man-made habitats. [ENC-002065] Bullfrog Films, Inc., toll-free: (800) 543-3764 **$49.00**

Zoo (1990)
Part of the *Smithsonian World* series, this video examines the relationship between humans and animals. This program explores the history of zoos, the human need to connect with animals, and how that relationship has changed over the centuries. The video describes early display zoos and the habitat zoos of the late 19th century, which provided the model for today's zoos. Viewers are presented with a behind-the-scenes look at the National Zoo in Washington, DC, and the lives of animals such as Hercules, a gorilla who rejected several potential mates over the course of 27 years and only accepted a mate after being shipped to another zoo. The video uses this example and others to discuss the problem of endangered species. Viewers are invited to consider the pros and cons of life in captivity versus life in the wild. [ENC-010074] Unapix/Miramar, toll-free: (800) 245-6472 **$19.98**

Temperate Forests: Teacher's Manual

Grades 4–6

1995

Series: Habitat Ecology Learning Program (HELP)

Publisher

Bronx Zoo/Wildlife Conservation Park
Education Department
2300 Southern Boulevard
Bronx, NY 10460
Toll-free: (800) 937-5131
Telephone: (718) 220-5131
Fax: (718) 733-4460

1 set: **$59.95**

Author

Developed by the Wildlife Conservation Society; resource developers, Don Lisowy, Judy Unis, Melissa Wimer, Susan Zoldak

Funding

National Science Foundation (NSF); Liz Claiborne Foundation

This activity book, part of the *Habitat Ecology Learning Program* (HELP) series for grades 4–6, uses illustrations and simple text to introduce students to temperate forest communities. The series focuses on environmental issues and highlights five habitats: rain forests, temperate forests, deserts, grasslands, and wetlands. Each book covers key concepts concerning the problems that affect the habitat and includes detailed lesson plans with experiments, field trips, games, simulations, and science reading. In this book, students learn about the seasons in a forest and complete a food web that allows them to examine the links between all species in the forest. Students also learn about the Cherokee people who live in the Great Smoky Mountains, discuss acid rain and its effects on forests and wildlife, and explore the issues surrounding old growth forests, including their value and the reasons for their disappearance. In addition, students examine the use of forests and forest products, learn about endangered species such as the Peregrine falcon and the Indiana bat, and discuss forest management. They also learn of the fate of Maple Grove, a temperate forest in the United States that harbors an endangered species. Sample activities in the book include presenting and comparing climate data, creating hypotheses and writing an experiment outline, calculating population statistics, and simulating a town board meeting. Also included are slides and a chart that summarizes the aims, objectives, and activities of each lesson in the book. (Author/RA) [ENC-009080]

Related Resources

ENC has other resources from the *HELP* series in its collection, including:

How Nature Works: Teacher's Manual (1995)

This book provides an overview of the key ecological concepts that are essential to understanding habitats. It begins with basic questions about how nature works and goes on to discuss how the distribution of solar energy, climate, and seasonality affect the distribution of habitats around the world. Also illustrated are the relationships between species and the habitats in which they live. Additional topics include food webs and energy flow, taxonomic classification and adaptations, and the connection between human population growth and environmental degradation. Sample activities ask students to write essays, plays, and poetry; create and interpret graphs; and construct food webs. [ENC-009078] (See above for contact information.) **$39.95**

Wetlands: Teacher's Manual (1995)

Students explore the five major types of wetlands through this book's activities, which include examining the physical adaptations of wetland animals and conducting experiments to determine whether lima beans can grow in salt water and in waterlogged conditions. Readers also learn how different groups of people use wetland resources, examine society's conflicting claims on wetlands, and study the negative effects of dumping garbage and pollutants into wetlands. In addition, the book considers the problems faced by wildlife when humans destroy or degrade wetlands, and asks students to design plans to help to save an endangered wetland species. Sample activities involve building wetland models, writing essays, calculating acres of wetland loss, and conducting surveys. [ENC-009082] (See above for contact information.) **$59.95**

Diversity of Lifestyles, Module I

Grades 6–8

1992 **Series: Wildlife Inquiry Through Zoo Education (WIZE)**

Publisher

Bronx Zoo/Wildlife Conservation Park
Education Department
2300 Southern Boulevard
Bronx, NY 10460
Toll-free: (800) 937-5131
Telephone: (718) 220-5131
Fax: (718) 733-4460

1 curriculum kit: **$299.95**

Author

Developed by New York Zoological Society; developed by the Bronx Zoo in cooperation with Philadelphia Zoo, Riverbanks Zoo, and Topeka Zoo

Funding

National Science Foundation (NSF)

Project WIZE developed this kit as part of a curriculum module that helps teachers and students utilize their local zoo to learn about animal habitats and adaptations. *Project WIZE* is organized into modules, each of which covers a different aspect of wildlife survival. This kit, Module I, focuses on natural habitats and how wild animals have adapted to meet the survival challenges posed by their habitats. The kit contains student resource books, worksheets, and discovery cards, in addition to a teacher's manual with 26 lessons that divide animal habitats into three units: "Animals of the Land," "Animals of the Water," and "Animals of the Air." Topics covered include vertebrate characteristics, diet and dentition, and locomotion and flight. In sample activities, students design burrows appropriate to the needs of various animals and calculate how many acres of Brazilian rain forest habitat are being destroyed each day. Included with each lesson are learning objectives, questions to motivate student inquiry, a materials list, and procedures, as well as background information and answer keys. Each unit is highlighted by a visit to the local zoo, which provides an opportunity for authentic assessment as students complete observation activities and lessons. After reading about land animals, for example, students visit the zoo to observe three basic types of foot stance and describe how these relate to movement and habitat. The student resource book provides background reading that supplements classroom lessons, along with illustrated discovery cards that highlight specific survival issues and provide related questions. Exploration of animal survival strategies is continued in Module II. (Author/LCT) [ENC-008987]

Pablo Python Looks at Animals

Grades K–1

1988

Publisher

Bronx Zoo/Wildlife Conservation Park
Education Department
2300 Southern Boulevard
Bronx, NY 10460
Toll-free: (800) 937-5131
Telephone: (718) 220-5131
Fax: (718) 733-4460

1 teacher's kit: **$299.95**

Author

Education Department of the Bronx Zoo/Wildlife Conservation Park; Wildlife Conservation Society

Standards

National Diffusion Network (NDN)

Through a discussion of zoo animals, this introductory multimedia life science curriculum teaches students science concepts relating to color, sound, and behavior. The kit may be used as a complete curriculum or as a supplement to an existing curriculum. A video features individual segments that illustrate and explain the characteristics of life, growth, locomotion, and eating habits. Six colorful posters illustrate characteristics described in the video, as well as other concepts relating to color, shape, and sounds. The teacher's manual includes items such as basic and advanced lessons, vocabulary lists, and evaluation materials. Six illustrated children's science books present information and activities that explore the same topics featured on the posters and video. Each book is accompanied by a selection of activity sheets designed for students at various levels. An audio cassette presents sounds made by different animals. One side of this tape is narrated; the other is not. (SSD/Author) [ENC-009832]

Wetlands: Ecological Powerhouses

Grades K–4

1997

Publisher

Columbus Zoo
Education Department
9990 Riverside Drive
PO Box 400
Powell, OH 43065-0400
Telephone: (614) 645-0551
Fax: (614) 645-3465

1 text: ***$5.00***

Author

Ohio Department of Natural Resources, Division of Wildlife, Columbus Zoo, Sport Fish and Wildlife Restoration

Standards

Ohio Science: Ohio's model competency-based program (1994); Project 2061 (1985)

The Columbus Zoo Education Department developed this resource book with lessons and activities for five wetland field experiences at the zoo. Each lesson provides pre-visit preparatory activities that introduce science concepts, a list of places to visit at the zoo, and suggested discussion questions and activities for each site. Also included are suggestions for post-visit and extension activities that integrate mathematics, map skills, literature, and art. In the lesson on fresh water frogs and toads, for example, students prepare for their visit by packing the frog's lunch bag with a variety of paper insects and small animals, read the children's book *The Very Hungry Caterpillar* to learn about metamorphosis, and make a book on a frog's metamorphosis from egg to adult. At the zoo, the children visit the Johnson Aquatic Complex to observe various frogs in their habitats, go to the Arthropod Building to examine the habitats of wetland insects, and observe frogs at Moose Pond. After the field trip, students look for frog-friendly habitats on their school grounds or create a habitat in the classroom. In additional trips, students learn about other animals that inhabit the wetlands, lakes, and ponds, as well as about the characteristics of waterfowl and otters and the importance of wetlands in pollution control. The resource book provides a glossary, reproducible masters of student worksheets, and background information for teachers. (Author/LCT) [ENC-009427]

Related Resources

Bat World (1997)

Students' misconceptions about bats are addressed in this resource book, which provides background information, activities, and a select bibliography. The background information includes a list of bat facts, essays on the brown bat and the hoary bats indigenous to Ohio, and a vocabulary list, as well as a bibliography of books and videos about bats. In sample activities, students read and discuss a short article about bat courtship rituals and create a pendant that promotes the benefits of bats to the environment. [ENC-009791] (See above for contact information.) **$5.00**

The Baking Deserts (1997)

This book describes the formation of deserts and their characteristics. It includes a glossary, a list of facts about deserts, and a bibliography of books and videos. Some activities require students to identify common desert animals, compare a cactus to a tropical plant, and study how a camel is adapted to life in the desert. [ENC-009792] (See above for contact information.) **$5.00**

Tickled by a Gorilla, Kissed by a Whale: Career Paths of Women Who Work to Save Wildlife (1997)

These profiles of 28 women who work for the Wildlife Conservation Society (WCS) describe a variety of careers, ranging from animal care and research to computer information systems and graphic art design. Each profile includes a photograph of the woman and a general description of the personal and professional demands of her job. Also included are descriptions of a typical day's work and the education and experience required for the position. [ENC-011545] Bronx Zoo/Wildlife Conservation Park Education Department, toll-free: (800) 937-5131 **$14.50**

The Salamander Room

Grades Pre-K–3

1993

Distributor

Great Plains National (GPN)
Orders
PO Box 80669
Lincoln, NE 68501-0669
Toll-free: (800) 228-4630
Telephone: (402) 472-2007
Fax: (800) 306-2330
E-mail: gpn@unl.edu

1 videotape: **$45.95**

Author

Produced by Robin Fogelman; directed by Mark Mannucci; written by Ronnie Krauss

Funding

National Science Foundation (NSF); Corporation for Public Broadcasting (CPB); W.K. Kellogg Foundation

Series: Reading Rainbow

Part of the *Science Comes Alive* series by *Reading Rainbow*, this video is designed to encourage and motivate young children to read good books and visit their local libraries. Each *Reading Rainbow* show is an upbeat, magazine-format adventure featuring a children's picture book and a medley of other segments related to the book's theme. Program segments supplement the book with animation, dramatizations, interviews, music, and book reviews, written and delivered on-camera by kids. This series is designed to foster positive scientific attitudes by integrating science into the grade-school curricula. Through reading books with a scientific theme, children explore new ideas, travel to new places, and learn how things work. This video, *The Salamander Room*, features a book about a little boy who adopts a pet salamander and learns that there is more to creating an animal habitat than meets the eye. Host LeVar Burton guides viewers through Jungle World, a simulated rain forest at the Bronx Zoo, to learn how this environment was created. In addition, the video introduces unusual rain forest animals, such as the proboscis monkey, and shows how a blimp is used as a flying laboratory to study the rain forest from above. The teacher's guide identifies the scientific concepts embedded in each program and provides interactive, hands-on activities for both home and the classroom. In sample activities, students research the animal of their choice, then create a habitat diorama; discover what kinds of food most interest insects; and examine the small creatures that inhabit schoolyard trees and bushes. A supplementary book list is also provided. (Author/LCT) [ENC-005740]

Imogene's Antlers

Grades Pre-K–3

1987

Distributor

Great Plains National (GPN)
PO Box 80669
Lincoln, NE 68501-0669
Toll-free: (800) 228-4630
Telephone: (402) 472-2007
Fax: (800) 306-2330
E-mail: gpn@unl.edu

1 videotape: **$45.95**

Author

Produced by Cecily Truett and Larry Lancit; directed by Mitchell Geller; written by Joan Wilen, Lydia Wilen, and Patti Sullivan

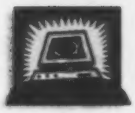
Funding

Carnegie Corporation of New York; National Science Foundation (NSF); B. Dalton Bookseller; Corporation for Public Broadcasting (CPB)

Series: Reading Rainbow

This video shows children that an animal's appearance can provide important clues about where and how it lives. It features a book about a little girl who wakes up one morning to discover that she has grown antlers overnight. What transpires is a hilarious adventure that illustrates how Imogene's antlers can be put to practical use. Host LeVar Burton takes a trip to the Philadelphia Zoo and gets a close-up look at various animals displaying their horns, antlers, feathers, colors, and stripes. The teacher's guide identifies the scientific concepts embedded in each program and provides interactive, hands-on activities for both home and the classroom. In sample activities, students brainstorm uses for antlers and brilliant plumage, write a comic strip about a conversation between two animals, and draw a picture of themselves that features at least one animal characteristic, such as as feathers, a trunk, or a tail. A supplementary book list is also provided. (Author/LCT) [ENC-012231]

World Wide Web Sites
Zoos



ZooNet
http://www.mindspring.com/~zoonet/

The winner of numerous awards, this site provides information and links to zoos all over the world. Photographs, fact sheets, and scientific and common names may be accessed for many types of animals. The site includes a directory of zoos both in the United States and elsewhere, with links to the zoos that have their own Web sites. Some of the zoo sites offer games, quizzes, and puzzles for children. Additional links provide access to animal information search engines, conservation organizations, and other animal-related sites. A section called "Virtual Zoos" lets students visit online zoos to see animal pictures, hear the sounds they make, and watch them move. [ENC-009505]

San Diego Zoo
http://www.sandiegozoo.org/

Designed for students of all ages, this site presents information and photographs on the animals, plants, and programs at the San Diego Zoo. Photos depict animals such as the Galapagos tortoises, Komodo dragons, and okapis, and information is available on exotic animals like Douc Langurs, Takins, and Hornbills. The site provides information about the Center for Reproduction of Endangered Species along with a list of factors that affect extinction. Teenagers in the zoo's intern program have written online journals about topics ranging from animal behavior to tips for aspiring veterinarians. Press releases describe recent events, new products, and developments at the park. Games are available online in which students match animal tracks and special diets to the correct animal. Listings are also available for all of the zoo's current educational programs and special events. Winner, ENC Digital Dozen (July 1997). [ENC-010778]

Zooary
http://www.ceismc.gatech.edu/zooary/

A teacher developed this Web site to be the online component of a classroom zoo that helps students apply the fundamental concepts of biology, chemistry, environmental science, physical science, and ecology. The site introduces students to possible zoological careers, environmental concerns, and conservation. The "Animal Information" section contains student research reports and pictures of animals in the Zooary. Each report includes the animal's taxonomic classification, habitat, diet, gestation, and longevity, as well as conservation efforts on its behalf and a bibliography. "Teacher's Tidbits" include a guide to using zoos in school, lesson plans and activities, and suggestions for constructing a zoological newspaper. Winner, ENC Digital Dozen (October 1996). [ENC-002109]

Cincinnati Zoo and Botanical Gardens
http://www.cincyzoo.org/

The Cincinnati Zoo and Botanical Gardens Web site presents information about the zoo's animals, gardens, and program, providing pictures and background information of animals such as tigers, lowland gorillas, and okapis. Online articles from their magazine, *Wildlife Explorer*, cover topics such as white tigers and tapirs, animal body language, cheetahs, and Komodo dragons. The site also offers games in which students can guess the animal of the week and match animals with their characteristics. Teachers will find printable files of lesson plans on subjects such as biodiversity, classification, and animal behavior. Environmental materials feature information on contacting government representatives about environmental issues and tips for backyard conservation habitats. [ENC-011348]

The Electronic Zoo
http://netvet.wustl.edu/e-zoo.htm

This Web site categorizes and organizes veterinary, medical, and animal-related information on the Internet into a format that is relevant and easy to use. Hundreds of links connect to information about animals of every shape and size imaginable, both real and fictional. Users can learn about amphibians, primates, birds, cats, dogs, horses, ruminants, and invertebrates. They can also take virtual field trips to Lincoln Park Zoo in Chicago or to one of the other zoo pages. Information is provided about joining mailing lists and newsgroups about animals. Visitors can get the latest news about their favorite animals by looking at a few of the many online magazines featured here. Information about sick pets can be found under "Veterinary Services" or "NetVet," a sister home page, as well as electronic textbooks and review materials for subjects such as biotechnology, comparative anatomy, immunology, and animal husbandry. Winner, ENC Digital Dozen (August 1995). [ENC-008638]

Birmingham Zoo
http://www.bhm.tis.net/zoo/

The Birmingham Zoo site provides visitors with information on all types of zoo-related topics. Users can search an index of animals by their common names—such as cougar, elephant, polar bear, or kangaroo—and get pictures, scientific names, habitat, and other facts on that animal. The "Animal Omnibus'" is a list of Web sources indexed by the name of the animal. Animal videos are available for viewing, showing scenes such as peacocks displaying tail feathers and how a bat's wing is like a human hand. *Animal Tracks*, the zoo's online newsletter, posts information on upcoming zoo events and articles on the zoo's animals and staff. Photographs are included from a staff member's trip to the Galapagos Islands and an African safari. Links to related sites are also provided. Winner, ZooNet Gold Paw Award (May 1996). [ENC-008642]

Section III: Aquariums

Nothing Beats the Real Thing:
Interview with Dr. Valerie Chase

Julia L. Harris
ENC Publishing Group

"We offer the opportunity to have your nose two inches from a real ten-foot shark," exults Dr. Valerie Chase, Staff Biologist at the National Aquarium in Baltimore. One presumes, of course, that there is a healthy thickness of window between one's nose and the real ten-foot shark . . . Nonetheless, the point is well made: there is something unmistakably vital and impressive about seeing a shark in a tank that just can't come from looking at a shark in a book or a video—even if that video is the blockbuster movie Jaws. *"No matter how wonderful a video is, kids still are left wondering 'Well, is it real?'" says Chase.*

At the National Aquarium in Baltimore, all doubts are banished as to the reality of the animals and plant life in the exhibits. As Chase says, the aquarium offers "living exhibits" that allow children to experience aquatic organisms in a way that is authentic and conducive to meaningful learning, particularly when a visit is coordinated with what is going on in the classroom.

There are many ways this can be done: a trip to the aquarium at the beginning of a classroom unit to motivate and prepare the children to learn; a trip in the middle of a unit to gather data and material that can be analyzed in class; or a trip at the end of unit as a summative experience to bring together all the material that has been taught in the classroom. "One teacher at a private school in Baltimore brings her students here in September to set up a unit for the whole year," Chase notes. "The field trip is the time for the classes to bond, learn how to work together, and establish their working groups for the year."

© Valerie Chase (NAS)

Children at the touch pool area of the aquarium.

Most teachers, however, don't start the year out with a field trip. The aquarium is visited by more than 200,000 children a year, and since most schools want to schedule field trips in April and May, overcrowding becomes a real issue and can make it difficult for students to fully appreciate what the aquarium has to offer. "Our Fridays in May already have 3,000 students booked," Chase comments. On the other hand, for teachers who come in October, the place is less busy and students have room to explore. The same is true with parents: the majority want to come at 10:00 or 11:00 on Saturday morning, but the building is fairly empty on a Friday night. Choosing to visit at times that are not peak visitation hours is a simple way to give yourself a head start when planning a trip to the aquarium.

Another thing to consider when arranging a visit is the importance of giving students some advance preparation as to how to behave and what to expect, particularly in terms of the physical structure of the aquarium: "Our building is very challenging—no floor is like any other floor in terms of structure. It has moving walkways that cross over open space, a ramp that spirals down five flights, and places where it is pitch dark with strange noises coming out of the walls," Chase says. "Kids are so excited to see what comes next that they don't look at anything—some have made it through the entire building in 20 minutes! Being in a totally novel environment, they get excited and tend to act out; it gets noisy, and there's pushing, shoving, karate kicking, etc." The aquarium now provides a video that shows the precise layout of the building, so that instead of worrying so much about what is coming next, the students are free to focus on what is right in front of them.

Chaperones can play an important part in making the visit a meaningful one for students, encouraging them to ask questions about the exhibits and talk about what they are doing and thinking. Parents, too, can help their children learn by asking questions instead of telling them about the exhibits, so that the family is learning as a group. Aquarium volunteers are trained to answer many of the common questions children and other visitors may ask. For questions they are unable to answer, they take a name and address and research the question before getting back with a response.

Timing Is Everything

In her 18 years at the aquarium, Chase has had the chance to observe students as they go through the exhibits, and she has noticed that they seem to learn more if they are given the opportunity to think and interact with the exhibits rather than having to concentrate on detailed and involved worksheets. "Often, teacher-generated worksheets can be somewhat long, with a lot of material for the kids to read. The challenge is to have short, thought-provoking tasks at exhibits that will accommodate everybody at once." At smaller exhibits, only a few children can see what is going on inside the tank, so the group participation is lower and attention spans wander, possibly leading to disruptive behavior.

One particular favorite among students is an activity that can be done at the Atlantic Coral Reef, the aquarium's largest exhibit at 110 feet long with 335,000 gallons of water. With tape measure and stopwatch in hand, students identify a fish and follow it across a couple of windows, timing the fish to see how long the journey takes. After repeating the trial three times, they select another fish that swims with different fins and do the whole activity all over again. Through this exercise, students learn about the correlation between a fish's anatomy and the speed at which it swims. "What they come up with is that fish that swim with their tails move the fastest, while the guys that paddle with their pectoral fins are slower—and the porcupine fish are pretty darn slow," Chase says. "If you want to use college terms, what we've done is introduce the concept of functional morphology."

The goal of these and other activities is to engage the children and to get them to collect specific information that they can then take back to their classrooms and apply. Aquarium staff work hard to make sure that their school program supports formal education and the learning that goes on in classroom settings. The materials they produce are aligned with national documents such as the AAAS *Benchmarks for Science Literacy* and the *National Science Education Standards*. These documents have been useful in helping staff think about how kids learn and the ways in which they should be instructed, which has led them to consider the amount of time students need to reflect on new material and grapple with it in order to fully learn it. "Many programs are like quiz shows in terms of the speed at which they move, and that is not really fair to kids," Chase notes. The National Aquarium is evaluating its own programs in light of current educational research and soliciting feedback from educators to ensure that their programs support how students and their teachers are being assessed in the classroom.

© 1997 Lee Ann Cordell

Valerie Chase demonstrates water sampling techniques.

Creating Site Visits

For schools and communities that don't have an aquarium close enough to visit, Chase says, teachers should consider taking their classes to other aquatic locations such as a salt marsh, freshwater wetlands, a sandy beach, rivers, or a pond. Just as with a visit to an aquarium, students should be prepared in advance as to what they can expect at the site and what the different habitats are around it. One way of involving them in the learning process is to have them help plan the trip and select the kinds of gear that will be needed to observe animal behaviors and possibly—with enough planning and guidance—collect samples. "We try to model the kinds of behaviors that scientists do," Chase explains.

In whatever setting you choose—whether an aquarium or a field site—your goal should be to provide a learning experience that is rich in meaning and real-world authenticity. "Research tells us that going to any informal education facility changes kids' attitudes," Chase says. "If kids get real preparation and real follow-up, then the aquarium and the field sites can support real content learning—and the students may get really excited about animals!"

© 1997 George Grall (NAS)

NSF Teacher Institute held at the National Aquarium.

Seashore Life on Rocky Coasts

Grade 7 and up

1993

Series: Monterey Bay Aquarium Natural History Series

Distributor

Monterey Bay Aquarium
Gift and Bookstore
886 Cannery Row
Monterey, CA 93940-1085
Telephone: (408) 648-4952
Fax: (408) 648-4994
E-mail: giftstore@mbayaq.org
http://www.mbayaq.org/

1 text: Order # 18813 **$9.95**

Author

Judith Connor; series and book editor, Nora L. Deans

The Monterey Bay Aquarium publishes this book about the habitats, behavior, and diversity of organisms found in the coastal zones. The book looks at six habitats, as well as organisms that move from shore to sea and change habitats. Descriptions are given of each habitat's organisms and the adaptations necessary for those particular conditions. Habitats featured include the rocky shore, the area above the tide that gets splashed with water, and the tide pool, as well as areas under water at low, mid, and high tides. The entire book is illustrated with color photographs, including starfish, algae varieties, and barnacles. The biodiversity found in these habitats is described and illustrated with reference made to the interrelatedness of the organisms. (SSD) [ENC-011514]

Related Resources

ENC has other titles from this series in its collection, including:

Elkhorn Slough (1989)

In this book, the focus is on Elkhorn Slough, a fossil river that was once fresh water but, due to the changing sea levels of the adjacent Monterey Bay, has become a dead-end saltwater river affected by the bay's tides. In times of heavy rain, the slough becomes an estuary as fresh water creeks overflow and dump water into the slough. Primarily a marsh of pickleweed—a hardy succulent plant—the slough provides a variety of habitats with harsh and changing conditions that lead to the great diversity of life found there. The biodiversity found in these habitats is described and illustrated with reference made to the interrelatedness of the organisms, which include birds, fish, invertebrates, and plants. At the end of the book, a list enumerates common species that inhabit the slough. [ENC-011515] (See above for contact information.) **$9.95**

Kelp Forests (1989)

This book discusses the habitats and diversity found in the kelp forests of the west coast. Kelp is a variety of brown algae or seaweed that has a number of adaptations, such as holdfasts, floats, and a conduction system similar to land plants that allows it to grow huge in size. A number of unique habitats are found within a kelp forest, such as those around the holdfasts, those along the stem or stipe, and those along the bottom. The book discusses organisms such as fish, invertebrates, and sea otters. Color photographs depict jellyfish, algae varieties, and sea urchins, among others. The book also describes and illustrates the biodiversity in this environment. A list of common species that inhabit the kelp forest is found at the end of the book. [ENC-11516] (See above for contact information.) **$9.95**

Saving Inky

Grades 4–6

1994

Publisher

National Aquarium in Baltimore
Education Department
Pier 3, 501 East Pratt Street
Baltimore, MD 21202
Telephone: (410) 576-3887
Fax: (410) 659-0116
http://www.aqua.org/

1 videotape and guide: **$13.95**
Note: Please specify grades 1–3 or 4–6.

Author

Executive producer, Vicki Aversa; producers, Sam Green, Terry Georgia, Nick Caloyianis; directors, Nick Caloyianis, Lee Caughron; writer, Terry Georgia

Funding

United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Services, National Aquarium in Baltimore; United States Coast Guard; United States Environmental Protection Agency; Citicorp/Citibank

After six months of convalescence at the National Aquarium in Baltimore, a pygmy sperm whale is released back into its natural habitat. This video and companion curriculum booklet tell the remarkable story of how the whale was first rescued, then rehabilitated, and finally released successfully. The program also discusses marine debris and general conservation. The curriculum booklet provides background information and seven activities that include an integrated mathematics and art activity in which students reproduce a scale chalk drawing of an actual whale on the pavement of their school. Students will also learn about echolocation as they are blindfolded and asked to find the wall of their classroom by sounds. A third activity entails making an inventory of the litter in the school yard. Reproducible student worksheets and bibliographic references are included. (Author/LCT) [ENC-011509]

Related Resource

A Future in Fish (1996)

This video, developed for general audiences, provides an overview of some of the career opportunities at the Aquarium. Viewers take a behind-the-scenes look into the typical working day of five staff, including the staff veterinarian, aquarist, mammalogist, and horticulturist. A companion curriculum packet is also available. [ENC-011512] (See above for contact information.) **$10.95**

Deep Sea Missions (1994)

This video and lesson guide highlight James McFarlane and his duties as Chief Remotely Operated Vehicle Pilot for the Monterey Bay Aquarium Research Institute. Students join McFarlane as he takes Mary Silver, a professor of marine biology, to the ocean floor to collect fragile marine samples. A sample activity asks students to calculate pressures for given depths and develop a rule for finding pressure at any depth. Independent extensions are also included, with annotations indicating their mathematical content. A lesson guide offers suggested discussion topics and related vocabulary words to be introduced before the video. In addition, it outlines key elements that can be discussed after the video and lists related integrated activities by topic. Related subject areas are language arts, science, art, literature, music, and geography. Also provided are student handouts, answers, and sample solutions. [ENC-003647] Great Plains National, toll-free: (800) 228-4630 **$39.95**

Living in Water: An Aquatic Science Curriculum for Grades 5 to 7

Grades 5–7

1997

Publisher

Kendall/Hunt Publishing Company
Orders
4050 Westmark Drive
PO Box 1840
Dubuque, IA 52004-1840
Toll-free: (800) 770-3544
Fax: (800) 772-9165
http://www.kendallhunt.com/

1 text: ISBN 0-7872-4366-3 **$23.95**

Author

Department of Education, National Aquarium in Baltimore

Standards

Benchmarks for Science Literacy; National Science Education Standards (NSES) (December 1995)

Funding

National Science Foundation (NSF)

This book is a classroom-based, scientific study of water, aquatic environments, and the plants and animals that live in water. It integrates basic physical, life, and Earth science with mathematics and language arts. Designed as a year-long curriculum, it may be modified to create a shorter module. Divided into six sections, it contains 50 activities on themes such as light in water, temperature changes, and aquatic habitats. Each section begins with a review of the background material for the teacher, followed by process-oriented activities for the students. Activities contain objectives, preparation, and an action section, which explains how to organize and carry out the activity. The activities are generated by guided questions from the teacher, with demonstrations and the proper materials provided for the students to use. Emphasis is placed on discussion groups. A results and reflection section and a conclusion section describe expected student outcomes. Students can study a topic in more detail through extension activities such as exploring the camouflage of underwater organisms, designing a surface-dwelling model animal, and examining the effects of nitrates on aquatic microorganisms. At the end of the book, a glossary defines key terms and a set of instructions is provided for making materials and solutions used in the activities. (SSD/Author) [ENC-011455]

Sea Searcher's Handbook: Activities from the Monterey Bay Aquarium

Grades Pre-K–8

1996

Publisher

Monterey Bay Aquarium
Gift and Bookstore
886 Cannery Row
Monterey, CA 93940-1085
Telephone: (408) 648-4952
Fax: (408) 648-4994
E-mail: giftstore@mbayaq.org
http://www.mbayaq.org/

1 text: Order # 47138 **$16.95**

Author

Contributing writers, Pam Armstrong, Judith Connor, Chris Parsons, Judy Rand, Jenny Vuturo-Brady; editor, Pam Armstrong

In this book students will find a collection of language arts, mathematics, and science activities that can be used to teach them about the habitats, organisms, and problems of the sea and shore areas. Although some activities involve trips to the shore, most of them are designed for the classroom and involve the use of reference materials about the sea. Habitats explored include the rocky shore, the open sea, and the kelp forest. Adaptations to various habitats are covered in reference to organisms such as marine mammals, fish, and sharks. The book considers the impact of humans, as well as the interactions of the organisms themselves. Activities include examining and graphing tide tables, making a clam costume, and determining what conditions cause plants to grow. The end of the book features a glossary and a list of helpful resources. (SSD) [ENC-011517]

Whales: K to 3 Teacher's Guide

Grades K–3

1994

Publisher

Sea World of Florida
7007 Sea World Drive
Orlando, FL 32821
Toll-free: (800) 406-2244
Telephone: (407) 363-2380
Fax: (407) 363-2399
http://www.seaworld.org

1 text: **$5.00**
Note: Also available on Sea World's Web site (see URL above).

Author

Developed by the Sea World Education Department

Sea World developed this teacher's guide to provide hands-on learning on whales and species conservation. The book consists of activities integrating science, mathematics, geography, art, and language. For each activity, the guide provides background information, objective, materials needed, procedure, and additional activities. Topics include facts about whales, such as anatomy, size, migration, communication, and diving depth. Additional discussion deals with the impact of human activities on the whales. For some species, students can look at drawings and read supplemental information about them. A bibliography, a list of readings and videotapes, and assessment activities are provided at the end of the book. (Author/RA) [ENC-003739]

Related Resources

ENC has other materials in its collection from SeaWorld of Florida, including:

Diversity of Life: 7 to 12 Teacher's Guide (1995)
This teacher's guide stresses the importance of diversity. Among other topics, it discusses the diversity of life and how living organisms are classified. Pictures and information describe some of the organisms in the animal kingdom and focus on the importance of interdependency among species. Each activity includes background information, objective, materials needed, procedure, and additional activities. A bibliography, a list of videotapes, and assessment activities are provided at the end of the book. [ENC-003728] (See above for contact information.) **$6.00**

Siren's Song: The Story of Manatees (1998)
Opening with a discussion of the mythological origin of *Sirenia*, the manatee's scientific order, this book presents the physical characteristics and habitat requirements of the Florida manatee as well as the human factors that endanger its survival. It also describes the manatee's evolution and taxonomy, along with its anatomy, reproduction, and feeding habits of manatees. Other topics include the devastating effects of habitat destruction, pollution, and recreational boating, and efforts to rescue and conserve the manatee. Color photographs depict a nursing baby manatee, the structure of a manatee's molars, and examples of the injuries caused by boat propellers and discarded plastics. [ENC-012182] (See above for contact information.) **$10.00**

Aquariums

National Aquarium in Baltimore
http://www.aqua.org/

The National Aquarium in Baltimore (NAB) site provides information about exhibits and educational programs, careers in marine biology, and ongoing research and conservation projects. The education pages provide a sampler of the curriculum booklets designed to support the NAB's programs. In sample activities, students read stories about marine animals and make a styrofoam model of a sea urchin. The education section also contains information on planning field trips and provides a listing of high school and college internships. In the animals section, users can take a quiz about the current exhibit, find information about setting up a home aquarium, and search on specific animals in the aquarium. Information about ticket prices, hours of operation, and employment opportunities is also provided. Winner, ENC Digital Dozen (February 1998). [ENC-011306]

North Carolina Aquariums
http://www.aquariums.state.nc.us/Aquariums/

The three North Carolina Aquariums were established in 1976 to promote awareness of the diverse natural and cultural resources of the state's aquatic environments. For each aquarium, the site provides hours of operation, a site map, and calendar of school programs and other events. Sample school programs include teacher workshops, a sleep-over with the sharks, and a cruise on the Cape Fear river. Visitors also have access to photographs and text that describe major exhibits. Additional information includes details about volunteer opportunities, aquarium publications, and links to related Web resources. [ENC-011587]

E-Quarium
http://www.mbayaq.org/

Visitors can take a virtual field trip to the Monterey Bay Aquarium's galleries and exhibits to see recreations of the bay's many habitats, from shallow tide pools to the vast open ocean. Other exhibits include a million-gallon indoor ocean, a three-story kelp forest, and "jewel boxes" that showcase smaller sea creatures. The site also provides visitor's information, educational resources, and information about the aquarium's conservation and marine research programs. Educational resources include workshops for teachers, a bibliography of suggested readings and online resources, and book reviews. [ENC-011382]

Florida Aquarium
http://www2.sptimes.com/Aquarium/Default.html

This Web site presents photos and biological information on Florida's aquatic organisms, including marine isopods, diamondback terrapins, and moray eels. The site also features "Lessons from the Sea," a sampling of the activities that were included in *Treasures from the Sea II: The Aquarium Story*, a teacher's guide by the Florida Aquarium and the *St. Petersburg Times'* Newspapers in Education program. A sample activity, called "The Naked Egg," demonstrates the semipermeability of a cell membrane by having students dissolve egg shells in vinegar. "Creature Feature" addresses the diversity of species that inhabit Florida's waterways. Users can view full-color images and descriptive text of fish such as the rock beauty, the foureye butterfly fish, and the jewfish. Winner, ENC Digital Dozen (July 1996) and Best of the Web (*PC Computing* magazine). [ENC-011383]

Animal Information Database
http://www.seaworld.org/

The winner of many awards—including Point Communications Top 5% of all Web Sites and a Magellan 3-Star site—this site was created by Sea World and Busch Gardens as an educational resource about marine and terrestrial animals. By increasing awareness of the interrelationships of humans and the marine environment, the site promotes conservation of natural resources. Brief fact sheets describe endangered animal species, and users can also access detailed articles about animal behavior, animal training, and ecosystems. Educational resources include programs for school groups, individuals, and teachers, and teacher's guides with hands-on activities that integrate science, mathematics, geography, art, and language. Winner, ENC Digital Dozen (February 1997). [ENC-002381]

Sea and Sky
http://www.seasky.org/

The last two great frontiers—the splendors of the sea and the wonders of the universe—are explored in this Web site. Visitors are invited to board either the Sub Cousteau for an undersea journey or the Starship Sagan for an outer space expedition. For each trip, the site provides a gallery of images, games, and related links. The solar system tour begins at the sun and contains color images from Skylab, SOHO, and the National Space Observatory. The tour continues through Mercury and Venus, the Terran, Martian, and Jovian systems, and concludes with asteroids and comets. The undersea journey contains two galleries with images of marine organisms, a tour of a coral reef, and aquarium resources. Winner, ENC Digital Dozen (January 1998). [ENC-011261]

Section IV: Amusement Parks

A Souvenir that Lasts a Lifetime:
An Interview with Richard Taylor

Julia L. Harris
ENC Publishing Group

Roller coasters aren't for everyone—anyone with a delicate stomach or a fear of heights can tell you that. For those people, amusement parks may seem like just one more way to throw money out the window: parking fee, admission fee, exorbitant prices for concessions—but at least there are funnel cakes, stuffed animals, and cool T-shirts to help sweeten the deal. But for many if not most people, a trip to the amusement park is an opportunity to look fear in the face and thumb their noses at it—and have a blast doing it. And for a certain population of students, amusement parks are a delightful new way to learn physics

Amusement parks across the country have been offering special Math and Science Days for quite some time, days when students can come and ride the roller coasters while learning about the physics behind them. Richard Taylor, a high school physics teacher at J.J. Pearce High School in Richardson, Texas, is the founding father of Physics Day at Six Flags Over Texas in Arlington. During his two decades of teaching, he developed the materials that students use to determine the velocity, acceleration, and other principles of physics that drive the major attractions at Six Flags.

"I taught at a school that only had 10 physics students, and no equipment to speak of, except for a light bulb and two batteries—one of which was dead!" Taylor laughs. "I was hunting around for physical things the students could do and take measurements on. So we went to the playground and we shot darts and we started going to Six Flags." At first, his excursions to the amusement park were done on Sundays, since that was a day when it was comparatively uncrowded. He was also teaching amusement park physics on his own, without the assistance or even knowledge of Six Flags.

At the time he started—1975—there really wasn't a national precedent for what he was trying to do with his students. When he approached the staff at Six Flags, they were very helpful: Taylor consulted with the engineers who had designed the rides and pored over blueprints, learning about their heights and velocities.

Roughly 10 years after Taylor first began taking students to the park, Six Flags Over Texas decided to adopt the materials he had written and make Physics Day an official park event. Taylor sent out letters to every high school physics teacher in Texas to inform them of the event and encourage them to participate. Physics Day has been a hit ever since—and Taylor himself now has more than 300 physics students. The larger group has brought with it some interesting logistical challenges: "At one point, I took a bullhorn and while we were standing in line at the ride, I would give a lecture. It was kind of interesting for the other people in line!"

High school students measure acceleration on the Texas Giant roller coaster at Six Flags Over Texas.

Even though Taylor can't help but be pleased at how the Six Flags field trip has helped stimulate student interest in physics, he maintains that the reason for taking classes to the park is to give them hands-on experience with physics. "We take students to Six Flags because classes are so compartmental—the students think that what goes on in their physics class is different than what happens in their math class," he explains. "But when you take them into the real world, out into an environment they've experienced outside the classroom, and show them that what we've been doing all year really does apply to the things they do every day, their eyes open." He makes the point that in the school lab, students

use equipment that they will most likely never encounter again, whereas they will be driving a car and getting on roller coasters for the rest of their lives. It is his goal to make sure that they continue to think about the physics implicit in these everyday activities.

The real-life, tangible experience of sitting in thundering roller coasters and actually feeling the incredible rush of acceleration is a far cry from reading about it in books or watching it on a video. "Books, CD-ROMs, and videos show you somebody else's idea of how the world is," Taylor says. Six Flags Physics Days offer students the opportunity to experience something with which they are familiar in a whole new way—without an intermediary "expert" to tell them what to think or how to feel.

Getting Ready to Roll

Before taking students to the amusement park, Taylor spends at least two days in class going over what previous students have done on past trips, showing slides and working through some of the worksheets. "Some of those worksheets look pretty scary," Taylor admits with a laugh. "So we go through them step by step and show the students what is expected." Students in the second-year physics class are also used as mentors and provide extra assistance as needed. In recent years, Taylor has added the use of calculator-based laboratories (CBL) to the physics problems students are asked to complete, and so a good portion of time is spent going over how to use them.

The Python at Busch Gardens.

Students actually take the CBLs home with them and spend time experimenting with them.

The content that students encounter in the problems themselves is mostly mechanics, which gets covered in the curriculum at the first part of the year. The trip to Six Flags generally takes place in the spring, so it serves as a fun and nonthreatening review of the material. Students are given problems based on five of the regular attractions at the park; solving those five, Taylor says, will earn them roughly a B grade. "We tell them that if they want a better grade, they have to find other rides or attractions and make up their own experiment." The point is to encourage students to think creatively and come up with their own ideas, and often Taylor is pleasantly surprised by the variety and cleverness of what they turn in: "One group decided to use the water fountain and calculated the velocity of the water that came out of it." No ceiling is put on the students' creative license, with the exception that they have to make their experiments quantitative and provide an abstract with data or graphs.

Taylor admits that he enjoys going to Six Flags Over Texas almost as much if not more than his students. The biggest thrill he gets out of the whole event, however, is the satisfaction that he's helping students become more attuned to how physics really does play into their everyday experiences. "Even though science is fun all of the time, this allows them to know that it is. They will be going to Six Flags for the rest of their lives, and every time they do from now on, they're going to think about physics."

Supplemental Web Resources

Roller Coaster Physics
http://pen.k12.va.us/Anthology/Pav/Science/Physics/book/home.html

Physics teacher Tony Wayne created this site to show how teachers can incorporate the principles of roller coaster design into the curriculum. The site assumes some basic knowledge of physical science and provides a simplified view of design and science considerations a mechanical design engineer must know when designing a roller coaster. Topics include velocity, acceleration, and gravity, as well as a demonstration of Galileo's experiments. Lessons and field activities are provided that apply these topics to hills and dips, loops and banked curves. Many of the classroom activities use the Roller Coaster Simulator (blueprints included), a flexible model of a roller coaster track designed to be mounted onto a magnetic blackboard. Each activity includes background information, reproducible handouts, and step-by-step instructions. The text of this site may be downloaded and printed with Adobe Acrobat. [ENC-011780]

The World Wide Guide to Roller Coasters, Parks, & Rides
http://www.demon.co.uk/arvis/wwg/

Suitable for students in grade 8 and up, this Web site explores the physics of roller coasters and other amusement park rides. The section on coaster dynamics includes information on constant acceleration and free fall, forces, and motion in a circle, as well as on differentiating between speed, velocity, and acceleration. Short biographies discuss Newton and Galileo and their contributions to the physics of gravity, motion, and free fall. Tables display velocity in free fall, centripetal acceleration, and conversion factors for length, area, and volume. The site also explains how roller coasters deal with gravity and loops. The anatomy of a roller coaster covers such topics as track types, car configurations, and safety. The site also lists information on roller coasters and amusement parks found around the world. [ENC-011384]

Curriculum Resources

Science Day Paramount's Kings Island Teacher's Resource Materials: General Science

Grades K–12

1998

Publisher

Paramount's Kings Island
6300 Kings Island Drive
Kings Island, OH 45034
Toll-free: (800) 568-5852
Telephone: (513) 573-5800

1 text: ***Free***
Note: Single copy provided to each school participating in Science Day.

Author

Paramount's Kings Island

Paramount's Kings Island Amusement Park prepared this resource guide for participants in science activities done at the park's Science Day. There are three sections to the book: a teacher's section, physical and biological science activities for high school, and science activities geared to the elementary level. The teacher's section contains samples of the various forms that might be necessary for arranging a field trip to the park, as well as an organizational checklist. References to other materials on amusement park science are provided, along with bulletin board ideas and pre-visit classroom activities. These activities include examining the need for accurate scientific reporting, investigating the effects of activity on pulse and breathing rates, and experimenting with different weights and lengths of pendulums. The high school park activities cover biological topics such as ecology, physical science topics such as acceleration and gravity, and chemical topics including corrosion and pH. For example, while riding one of the attractions, students are asked to evaluate their pulse and breathing rate before and after the ride and to explain the movements of their body as the car stops and starts. Elementary level activities include looking at the nutrition available at the park restaurants and experimenting with the physiology of vertigo on the carousel. (Author/SSD) [ENC-011555]

Related Resources

Six Flags Over Texas Physics Day: Teacher's Intermediate Guide (1997)
This packet, designed for intermediate physics classes, offers practical suggestions, problems, and activities to help students use the theme park as an exciting science laboratory. The packet provides guidelines for estimating time and distance measurements and provides the formulas for calculating the speed, size, and direction of acceleration. Additional materials include instructions for making a simple triangulation device and a vertical accelerometer, and a description of the course and dimensions for each ride featured in the packet. Bibliographic references, advance preparation checklists, blackline diagrams, and suggestions for teachers are also provided. [ENC-011886] Six Flags Over Texas, telephone: (817) 640-8900 Free to participants in Physics Day

Amusement Park Physics: A Teacher's Guide (1990)
Developed for middle school grades, this teacher's guide provides materials to implement an amusement park study program in the classroom. It addresses administrative details of arranging the field trip and provides educational objectives, references, and materials construction. The book also presents two different kinds of learning experiences: a teacher-centered, questioning approach and a student-centered, open-ended approach. Sample test questions are provided, as well as reproducible student laboratory exercises on triangulation and the use of a horizontal and a spring accelerometer. Background information and activities are included for selected rides, such as looping roller coasters and bumper cars. For those who can't attend an amusement park, a section supplies sample data that can be used in place of a trip. [ENC-006302] J. Weston Walch Publisher, toll-free: (800) 341-6094 **$20.95**

Paramount Parks Math Day High School Activity Booklet

Grades 9-12

1996

Publisher

Prentice Hall
4350 Equity Drive
PO Box 2649
Columbus, OH 43216-2649
Toll-free: (800) 848-9500
Fax: (614) 771-7361
http://www.prenhall.com/

1 activity booklet: ***Free***
Note: Single copy provided to each school participating in Math Day.

Author

Developed by Prentice Hall

This teacher resource packet was designed to help high school math teachers and their students take full advantage of the educational opportunities available during a Math Day at a Paramount theme park. The booklet and handout offer reproducible masters for activities, which are suitable for first-year algebra students. Some of the more challenging activities would also be appropriate for geometry, second-year algebra, and trigonometry or precalculus students. Each activity begins with introductory classroom work, procedures to be carried out in the park (including data collection), and wrap-up activities for after the park visit. In a sample activity, students investigate the parabolic shape of the arches and the pendulum motion involved in the Xtreme SkyFlyer, in which a "flyer" does a bungee jump from a 150-foot arch. In the classroom before the trip, students construct and learn to calibrate a clinometer, an instrument for measuring angles of elevation. At the park, they use the instrument to get measurements to determine if the big arches of the Xtreme SkyFlyer are parabolic and to test the physics formula for the period of the pendulum-like ride. Also in this packet is a complete teacher planning guide with connections to other subjects, extensions, ongoing assessment ideas, and supplementary readings. Information on individual parks is included as well, indicating monthly attendance, pounds of popcorn sold, and load capacity of rides. (Author/JRS) [ENC-011528]

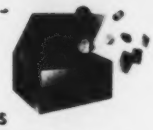
Related Resource

Paramount Parks Math Day Middle Grades Activity Booklet (1996)

As with the resource described above, this set of materials prepares students to fully benefit from participating in a Math Day at a Paramount theme park. Designed for middle grades, the booklet and handout offer reproducible masters for activities that include introductory classroom work, procedures to be carried out in the park (including data collection), and wrap-up activities for after the park visit. In a sample activity, students investigate a roller coaster to determine its angle measurements, heights, distances, and times. Students not only collect the data but also apply the Pythagorean theorem and the distance formula. A complete teacher planning guide is included with connections to other subjects, extensions, and ongoing assessment ideas. [ENC-011529] (See above for contact information and pricing.)

Roller Coaster Physics

Grades 8–12



1997

Series: K'NEX in the Classroom

Publisher

K'NEX Educational Division
2990 Bergey Road
PO Box 700
Hatfield, PA 19440-0700
Telephone: (215) 997-7722
http://www.knex.com/

1 kit: Order # 79301 **$240.00**

Author

K'NEX Education Division

This curriculum kit contains hands-on activities to help students investigate physics concepts in simple systems and then apply these concepts to build a complex roller coaster. The kit contains more than 3,000 K'NEX rods, connectors, and gears. In the teacher's guide are 10 modules that explore forces, motion, and energy. In the first modules, lab groups build inclined planes and ball loops, then investigate projectile motion, speed, and friction by changing variables on their models. The students then work cooperatively to build the K'NEX roller coaster. As they build the ramps, spirals, and loops, they learn about roller coaster physics and derive formulas through experimentation. Each module contains background information and worksheets for concepts and calculations. The background section provides an overview of relevant physics principles and equations, practical examples, and suggestions for implementing each module. The concepts worksheets contain formulas, measurement exercises, and inquiry exercises that ask students to make and test predictions about the behavior of the roller coaster, ball loop, or inclined planes. The calculations worksheets guide students through data collection and recording, simple error analysis, and data display in tables or graphs. Most of the exercises in the calculations worksheets require the use of algebra and trigonometry. Conversion charts, glossaries of vocabulary and formulas, and sample data charts are provided in the appendices. Bibliographic references and suggested videos and software are also provided. (Author/LCT) [ENC-012237]

Archibald Frisby

Grades Pre-K–3

1995

Series: Reading Rainbow: Science Comes Alive

Distributor

Great Plains National (GPN)
PO Box 80669
Lincoln, NE 68501-0669
Toll-free: (800) 228-4630
Telephone: (402) 472-2007
Fax: (800) 306-2330
E-mail: gpn@unl.edu

1 video: Order # S113 **$45.95**

Author

Produced by Kathy Kinsner and Mark Mannucci; directed by Mark Mannucci; written by Jill Gluckson

Funding

Corporation for Public Broadcasting (CPB); National Science Foundation (NSF); Pew Charitable Trusts; Arthur Vining Davis Foundations; W.K. Kellogg Foundation

Archibald Frisby loves science and uses his knowledge to have fun at summer camp. His experiences are chronicled in this video program, which is part of the *Science Comes Alive* series by *Reading Rainbow*. By reading books with a scientific theme, children explore new ideas, travel to new places, and learn how things work. In this episode, host LeVar Burton takes viewers on a tail-spinning ride when he climbs aboard the Great American Scream Machine, at New Jersey's Six Flags Great Adventures Amusement Park. Inspired by the book, LeVar takes a scientific approach to winning park games and shows that with the right questions and a little experimentation, an easy solution is always close at hand. For example, he shows how science has improved sports by using biomechanics and computer analysis to refine the technique of a young high jumper. He also shows historic footage of the development of seat belts and crash test dummies, and he describes how trial and error was important in developing ways for eating and drinking in space. The teacher's guide identifies the scientific concepts embedded in each program and provides interactive, hands-on activities for both home and the classroom. In sample activities, students discuss the work and tools of a scientist, set up a science camp in the classroom, and go to the school playground to try out scientific principles such as gravity, momentum, and levers. A supplementary book list is also provided. (Author/LCT) [ENC-005731]

Section V: Museums & Science Centers

Journeys of Exploration:
Interview with Dr. Rob Semper

Julia L. Harris
ENC Publishing Group

One year, the faculty at my elementary school decided to take everyone—it was a small school—to the Exploratorium in San Francisco. We had our worksheets, we divided into small groups, and we were allowed to wander about and look at whatever struck our fancy. I remember being somewhat reluctant at first to actually touch the exhibits, having been told at every other museum that touching was absolutely not allowed, but I was soon persuaded to get my hands in there with everyone else. And in my case, at least, the experience was an unqualified success: I remember more science from that one visit than I do from an entire quarter of astronomy in college. I remember standing in an exhibit of mirrors and seeing myself replicated too many times to count; I can still feel the intriguing non-pain pain of pressing my hands and face into a pin screen. Science came alive for me in a way that it never had before, and gave me a new sense of possibility—maybe science was fun, after all!

A visitor models her profile at the pin screen.

When I had the opportunity to talk with Dr. Rob Semper, Executive Associate Director of the Exploratorium, my first order of business was to ask if that pin screen is still there (it is). Dr. Semper has been with the Exploratorium for more than 20 years, and he enjoys watching students and adults become engaged with the museum's exhibits. The goal of the Exploratorium, and other science centers like it, Semper says, is to stimulate visitors to become active participants in their own learning. "Places like the Exploratorium are, in a sense, collections of ideas and points of view about nature as much as they are collections of objects," he says. "In a way, they are collections of experiences. The visitor is really in charge of their visit, and what interests them is what drives their visit."

Windows of Perception

The Exploratorium was started in 1969 at around the same time as other science centers were opening across the country. The premise behind these centers—there are now more than 200 of them—is to encourage visitors to explore nature on their own. When the Exploratorium first opened, its exhibits were mainly related to human perception, such as seeing, hearing, and touching. As it grew, the exhibits expanded to include more of the underlying science concepts involved with perception, including light, color, and sound waves. There are now more than 500 exhibits that cover nature and science, and 20 to 25 new exhibits are built each year to add to the collection. Ideas for these exhibits come from the Exploratorium's staff of scientists and artists, but also from visiting teachers and other interested members of the public. "We're a place not only of exhibits but of constant exploration in new ideas in science, and visitors are invited to come along with us on these journeys of exploration," Semper says.

Each year, the Exploratorium welcomes more than 600,000 visitors, and some of the most popular exhibits with students, Semper notes, seem to be those that deal with light and color. Sample exhibits on images and light deal with the nature of light and creating images, how light gets perceived, and some aspects of animal vision. "The perceptual exhibits are big favorites because they can tell you a lot about yourself as well as what you are seeing," he explains. "For example, not everyone sees the same thing; there is a great variation in how people see color or color differences." One way students can physically experiment with light and color is to shine a light through a prism and different color filters and observe how the light is spread out in a colored spectrum.

This tactile interaction with the exhibits is a key element in giving students a good grasp of what goes on in science and nature. The Exploratorium is not a museum where visitors stroll past interesting objects and admire them with their hands clasped behind their backs; no, here they are expected to actively explore and work with the mate-

Students explore together.

rials in front of them. "Our exhibits really require the visitor to do something," says Semper. "You have to be an active participant—you manipulate things and try them out for yourself to really satisfy your own questions." At one exhibit, for example, students can see how nerve cells work by stimulating actual nerve cells and watching the electrical response. At another, they learn about DNA by manipulating models that illustrate the double-helix construction. A staff of Explainers, mostly high school students from San Francisco, is on hand to help people interact with the exhibits, asking and answering questions. Interestingly, most of these Explainers, Semper notes, are not necessarily exemplary science students, yet after working for several months at the Exploratorium they have gained a wealth of knowledge about science and their own learning process.

Role Models of Inquiry

"The most important thing is not so much learning a particular fact or idea, but rather stimulating in students the notion of questioning, of even being interested in the first place," Semper says. He encourages teachers to bring their classes in at the beginning of the year rather than the end because it can generate an interest and a curiosity that can help drive discussions all year long. Hands-on interaction with science and nature can give children a visible and visceral understanding that can serve as the foundation for what they learn in the more formal classroom settings.

One way teachers can help make a trip to the Exploratorium successful is to come ahead of time and visit the museum without their students to get a sense of what is there. That way, the teacher has personalized the museum to an extent and is able to offer students a base of common knowledge to familiarize them with it as well. Some teachers have even developed worksheets based on the exhibits that they can have their students use while there. When at the museum with their students, teachers should participate with them as learners, even if that means not always knowing the answers to questions. "It's important for students to see teachers modeling the process of exploration," Semper explains.

Another possible preparatory activity is to have students make one of the exhibits in *The Exploratorium Science Snackbook: Teacher-Created Versions of Exploratorium Exhibits*, which is a compendium of modified exhibits that have been adapted to be less expensive and easier to create. After building some of the exhibits in the book, the students come to the museum and examine the exhibit after which their creations are modeled.

The Exploratorium offers more formal training and professional development for teachers at the K–5 level and the 6–12 level. Teachers from beyond the San Francisco Bay Area are encouraged to participate alongside local teachers in three-week-long summer workshops and follow-up activities. The K–5 program, called Institute for Inquiry, is designed primarily for professional developers and helps participants develop their skills in providing inquiry-based science professional development in their home districts. The Exploratorium Teacher Institute works with 6–12 grade teachers to develop teaching skills for science that are specific to the exhibit content at the museum.

© The Exploratorium
Experiencing a cascade of light.

"The exciting thing about informal education is that it can happen at almost any time, at places that are available to families, to students, and to teachers," Semper says. "Science centers and museums are places people come to all the time; they are part of the community educational enterprise that can be used in many different ways. People come here with a well-developed base of knowledge and ideas. But it is often the opportunities of surprise that become the key educational events."

© The Exploratorium
Mentoring hands-on science exploration.

Curriculum Resources

Grades 6–12

The Cool Hot Rod and Other Electrifying Experiments on Energy and Matter

1996

Exploratorium Science Snackbook Series

Distributor

The Exploratorium
3601 Lyon Street
San Francisco, CA 94123
Telephone: (415) 561-0393
Fax: (415) 353-0481
http://www.exploratorium.edu/

1 text (paperback): ***$10.95***

Author

Paul Doherty, Don Rathjen and the Exploratorium Teacher Institute

The San Francisco Exploratorium, a museum of science, art, and human perception, developed this book as part of a series of *Science Snackbooks*. The book presents more than 20 experiments that explore energy transformations and how they affect the everyday world. Each *Science Snackbook* describes how teachers can make miniature versions of museum exhibits using common, inexpensive, and easily available materials. The experiments in this book are designed to demonstrate how one form of energy can become another. In "Stripped Down Motor," for example, the energy of an electric current is transformed into movement. This very simple motor relies on the same principles of electric motors that power fans, blenders, and other electrical appliances. The flow of heat is considered in "Cool Hot Rod," an experiment that demonstrates that changes in temperature can make a copper tube shrink or expand. Each Snack begins with a drawing of the original exhibit on the museum floor and a photograph of the scaled-down version that readers can make, followed by a short introduction and a list of the materials needed. Other sections give assembly instructions, contain descriptions of how to use the completed exhibits, and explain the science behind them. Most of the Snacks can be completed by one person, but those that require the help of a partner or adult are clearly differentiated. A section called "ETC." offers additional scientific and historic information. (Author/LCT) [ENC-012219]

Grades 6–12

The Cheshire Cat and Other Eye-Popping Experiments on How We See the World

1995

Exploratorium Science Snackbook Series

Distributor

The Exploratorium
3601 Lyon Street
San Francisco, CA 94123
Telephone: (415) 561-0393
Fax: (415) 353-0481
http://www.exploratorium.edu/

1 text (paperback): ***$10.95***

Author

Paul Doherty, Don Rathjen and the Exploratorium Teacher Institute

The 20 experiments in this book from the Exploratorium deal with visual perception, a topic in which biology and psychology interact to explain optical illusions. The experiments are designed to demonstrate how the eyes and brain interpret a variety of optical images. Some experiments, such as "Blind Spot," "Pupil," and "Afterimage," help readers understand more about the abilities and limitations of the eye. Others, like "Vanna" and "Far Out Corners," show how prior experiences often influence perception. Additional experiments demonstrate how the eyes and brain can create a complete image from very limited information or make some mistakes in their interpretation (optical illusions). Each Snack begins with a photograph of the scaled-down version that readers can make, followed by a short introduction and a list of the materials needed. Other sections give assembly instructions, contain descriptions of how to use the completed exhibits, and explain the science behind them. Most of the Snacks can be completed by one person. If a partner or adult help is needed, this is indicated. (Author/LCT) [ENC-012229]

Beyond Numbers: Elementary Guide

Grades 1-8

1995

Distributor

The Eisenhower National Clearinghouse
The Ohio State University
1929 Kenny Road
Columbus, OH 43210-1079
Toll-free: (800) 621-5785
Fax: (614) 292-2065

1 text: **Free**
Note: Electronically available through ENC Online at http://www.enc.org/classroom/focus/nf_index.htm *under the title: Informal Education in Math and Science. Free print copy available through the ENC Resource Center.*

Author

Developed by the Maryland Science Center and the mathematics faculty at George Washington University

Funding

National Science Foundation (NSF); IBM Corporation

"Beyond Numbers" is the Maryland Science Center's exhibit of modern mathematics, and this teacher guide was developed to provide lesson plans, activities, and worksheets to enhance classroom instruction with or without visiting the exhibit. The guide is designed to give the teacher background knowledge for the introduction of nontraditional problems in the classroom and to expand both the teacher's and students' definition of what mathematics is. Provided in the guide are eight nonroutine activities, several math songs, and four games from around the world. For example, the "Four-Color" activity provides all the materials needed for the class to investigate a classic mathematical theorem: Any planar graph (divided into any number of regions) can be colored with just four colors so that no two adjoining regions are ever the same color. For this activity students play the "Vertex Coloring Game" where they construct and color networks, then use reproducible maps from different sections of the country to experiment with coloring groups of states with fewer than four colors. Other activities deal with topics such as knots, Fibonacci sequences, and transformations. The guide includes a bibliography and a list of telephone numbers for useful resources. (Author/JRS) [ENC-011593]

Related Resource

Beyond Numbers: Secondary Guide (1995)
As with the elementary version of this guide, teachers can use these activities and lesson plans with or without visiting the Maryland Science Center's exhibit of modern mathematics, "Beyond Numbers." Included in this guide are nine nonroutine mathematical activities, several math songs, and four games from around the world. One sample classroom activity, "Periodic Tiling," has students use worksheets to compare and contrast quasi-periodic tiling with periodic tilings. Three worksheets with different tiling patterns (the Rhomburst, Penrose tiling, and periodic tiling) are included. In this activity, students investigate rotation and reflection symmetries and translations on these complicated patterns. In other activities, students are introduced to Venn diagrams, knots, graph theory, and numerical analysis. [ENC-011594] (See above for contact information and pricing.)

Astro Adventures

Grades 4–12

1994

Publisher

Pacific Science Center
200 Second Avenue North
Seattle, WA 98109-4895
Telephone: (206) 443-2851
Fax: (206) 443-3627

1 text with slides: ISBN 0-935051-02-3
$24.95
Note: Plus $4.00 shipping / handling

Author

Dennis Schatz and Doug Cooper

Funding

National Aeronautics and Space Administration (NASA); National Space Grant College and Fellowship Program; University of Washington; Washington Space Grant

In this astronomy curriculum book, 19 activity-based lesson plans help students explore the sun, moon, planets, and stars. Many of the activities are designed with open-ended tasks, problems, and challenges to encourage students to work together, using their problem-solving skills to determine suitable solutions to the exercises. The first unit, "Moon Gazing," allows students to express what they already know about the moon, as well as gather information to expand their knowledge. In the first activity, students examine lunar photographs and arrange them in the order they would expect to see the moon in the next weeks. A second activity asks students to observe the moon during a two- to four-week period, record their observations, and compare them to the sequence of photographs from the first activity. In subsequent units, students observe sunspots by projecting an image of the sun on white paper, and construct a star clock and use it to tell time at night. For each unit, the book features an overview, background information, and advanced preparation suggestions. For some activities, a teacher's note explains why the lesson is structured in a particular way and elucidates the type of student responses being solicited at that point. The unit also includes extension activities that integrate other subject areas, such as mathematics, social studies, and language arts. Eighteen slides of the planets are also included. (Author/LCT) [ENC-011546]

Brain Power: It's All in Your Head

Grades 5–8

1993

Publisher

Pacific Science Center
Brain Power Program
200 Second Avenue North
Seattle, WA 98109-4895
Telephone: (206) 443-2851
Fax: (206) 443-3627
E-mail: brain_power.org@pacsci.org
http://www.pacsci.org/public/education/sow/bp/default.html

1 text: ***$9.00***
Note: Plus $3.00 shipping / handling

Author

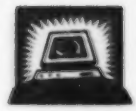
Developed by Pacific Science Center in cooperation with Group Health Cooperative

Funding

National Institutes of Health (NIH)

This curriculum packet covers brain structure, function, and memory, as well as learning, decision making, and health-related choices. Program components include a pre-visit workshop, the curriculum packet, and a visit to the school by the "Brain Power" exhibit. The pre-visit workshop is used to train both teachers and a group of students to use the materials in the curriculum packet, which includes hands-on activities, lesson plans, background information, and references. Lessons can be taught as a one- to two-week unit or spread throughout the regular curriculum. Student-led lessons include examining how the brain adapts to changes in perception, exploring the use of inkblots in the field of psychology, and practicing mental visualization to improve skills. The teacher-led activities are organized as a seven- or eight-day unit, starting with how we learn and know the world around us and culminating with some of the choices we make in daily life. In a sample activity, students make models of the brain out of potatoes and sand to demonstrate the size, weight and texture of the brain. An additional activity involves students in role-playing the different parts of the brain as impulses are sent through to carry out certain actions. Students also explore ways to overcome stress in their lives. Tips on teaching techniques and assessment are included as well. (Author/SSD) [ENC-011556]

World Wide Web Sites
Museums & Science Centers



Association of Science-Technology Centers
http://www.astc.org/astchome.htm

The Association of Science-Technology Centers (ASTC) is a nonprofit association of science centers, children's museums, and related institutions, including zoos, nature centers, planetariums and space theaters. Their Web site gives information about their educational programs, youth programs, and traveling exhibits. Features include a listserv for museum educators, exhibit developers, and researchers; behind-the-scenes stories about the work of museum educators; and articles about informal science education and museum education. Also provided are links to resources about accessible practices and reviews of ASTC publications relevant to education. Additional resources include a listing of science centers around the world, employment opportunities, and a schedule of the ASTC national conference. [ENC-011589]

Science Adventures: The Guide to Informal Science Centers
http://www.scienceadventures.org/

To help students, teachers, and parents locate informal science education centers throughout the United States, the Eisenhower Regional Consortia for Mathematics and Science Education maintains this Web site where visitors can search for centers in their own area. Visitors can use the search engine to find museums and science centers, planetariums and observatories, and zoos, aquariums, and aviaries. Information can also be obtained on nature centers, parks, and botanical gardens. For each site, visitors are given the location, hours of operation, and entrance fee as well as information about the center's goals and educational programs. [ENC-011288]

The Natural History of Genes
http://raven.umnh.utah.edu/

A partnership of Utah educators and scientists generated this project to develop a hands-on genetic science curriculum for the state's middle and high school teachers. Teachers are provided with resources and experimentation kits that bring disease genetics, conservation genetics, human diversity, forensics and DNA into the real world for students. For example, the "Introductory DNA Extraction Kit" enables students to investigate DNA in the classroom. The simple DNA isolation protocol is intended to motivate students to continue to discover the intricacies of DNA at home. In addition to activities designed for classrooms, this site also provides online activities, such as one that simulates the use of forensic genetics in the trial of a person who allegedly took artifacts from a prehistoric burial site. The evidence guides students in using genetic science to solve the case. This site also provides online books for teachers, directions for building laboratory equipment, and online registration for teacher workshops. Winner, ENC Digital Dozen (August 1996). [ENC-002029]

National Air and Space Museum
http://www.nasm.edu/NASMpage.html

At this site, users can conduct virtual field trips to the National Air and Space Museum (NASM), which houses the national collection of artifacts related to the development of aviation and space flight. The site offers a searchable index of NASM, the National Museum of Natural History, and the National Museum of American Art. All exhibits in the actual museum are available for viewing and may be examined in any order. Some examples include "Jet Aviation," "Enola Gay," and "Milestones of Flight." Other exhibits are "World War II Aviation," "Lunar Exploration Vehicles," and "Apollo to the Moon." For all exhibits, viewers can look at photographs and QuickTime movies and read about the history and context of each exhibit. Additional resources include online science activities such as the "Cyber Center," a simulated NASM research center where students can explore the mysteries of the solar system. Information is also provided on teacher workshops, which are designed to help educators incorporate NASM's resources into their classrooms. [ENC-003081]

Ocean Planet
http://seawifs.gsfc.nasa.gov/ocean_planet.html

Designed to be the online companion of "Ocean Planet," the Smithsonian traveling exhibition, this Web site promotes the study of environmental issues affecting the health of oceans. From the floor plan of the exhibit, users can go to any part of it to learn more. Sample areas include the museum shop, which contains photos, sculptures, and models illustrating the deep oceans, biodiversity, and ocean research. A resource room links to compilations of educational and oceanographic Internet resources, including scientific journals and other online exhibits. The room entitled "Oceans in Peril" contains photo murals and information that address topics such as marine pollution, habitat destruction, and global change. In the "Heroes" section, visitors can learn about the people who strive to help save the oceans, while the "Ocean Science" section discusses topics such as the effect of the ocean on climate and weather patterns, El Niño, ocean currents, and remote sensing. Also available in an online lesson book with six interdisciplinary lessons: "Sea Secrets" explores ocean geography; "Sea Connections" examines the plants and animals that live in different marine ecosystems; "Ocean Market" identifies and values many products of the seas; "Pollution Solution" examines the effects of an environmental crisis; "Stranded Along the Coast" explores both natural and human causes of animal strandings; "Reflections on the Sea" explores the influence of oceans on language and literature. Winner, ENC Digital Dozen (September 1995). [ENC-003412]

University of California Museum of Paleontology

Geological Time Machine
http://www.ucmp.berkeley.edu/help/timeform.html

Part of the Geology wing of the Paleontology Virtual Museum, this site contains extensive photographs of fossils from the Precambrian to the Holocene eras. For each time period, the site provides a timeline delineating the eras within the time period and the characterizing fossil record from each period. Clicking on the eras brings up more detailed information about each one. For example, within the Precambrian era visitors can click on the section of the timeline called Paleoprotozoic time period to find out about the fossils and geologic characterizations from that period. Searches can be conducted by three mechanisms, including taxa, geologic time period, and topic. Winner, ENC Digital Dozen (October 1995). [ENC-004040]

Enter Evolution: Theory and History
http://www.ucmp.berkeley.edu/history/evolution.html

Designed for grade 9 and up, this site provides information on the theory of evolution, cladistics, dinosaurs, and vertebrate flight. Links lead users to other areas of the museum's exhibits, including ones dealing with mammals or reptiles. A list of scientists who have been instrumental in the formation of evolutionary theory may be accessed to locate information on their work and lives. In the section on systematics, users will find information on why cladistics is important to classifying organisms of today and of the past, as well as instructions for creating a cladogram, or phylogenetic tree. An extensive bibliography lists additional resource, and terms are defined in a glossary. Winner, ENC Digital Dozen (March 1997). [ENC-009043]

The pH Factor
http://www.miamisci.org/ph/default.html

This site contains background information, lesson plans, and activities about pH. It is designed around the Seven E's, a constructivist approach to learning in which students build new learning based on their prior experiences. For the first E, Excite, the site offers activities to stimulate the learner's curiosity and proceeds to Explore activities designed to satisfy curiosity about pH. Background information is located under the Explain icon, where text explains the concept and defines the terms. Activities in the Expand section help students discover new applications, such as using acidic and basic solutions to determine which cleans copper pennies better. Extend contains suggestions to help teachers extend the concept into other content areas and Exchange provides teachers with an opportunity to share ideas, lesson plans, or experiences. The Examine icon provides ideas for alternative assessments. Winner, ENC Digital Dozen (July 1996). [ENC-002004]

Science Learning Network
http://www.sln.org/

Funded by the National Science Foundation (NSF) and Unisys Corporation, the Science Learning Network is an alliance of six science museums, each of which has partnered with a testbed school. The alliance was formed to support teacher development in science pedagogy and to provide resources not available within the walls of a traditional school. On the Web site, users will find links to the museum home pages, as well as home pages developed by the partner schools. For example, Avocado Elementary School, paired with the Miami Museum of Science, provides a listing of the Internet projects each classroom is developing in conjunction with the museum. A sample kindergarten project will create an alphabet using the animals of the Everglades. Student art work and voices will be used. General information about each school and its activities is also included. Winner, ENC Digital Dozen (January 1996). [ENC-004106]

WaterWorks
http://www.omsi.edu/sln/ww/

This introduction to the physics of water and the mechanics of moving liquids is designed to help teachers do more inquiry with students in the classroom. Within the site are teacher background discussions on the science and engineering behind fountains and on how classroom inquiry can be used to learn about scientific phenomena. Classroom investigations demonstrate how fountains work. For example the first investigation has students try to move water from one bucket to the other through a tube, and several illustrated ideas describe building fountains with simple materials. The Gallery features a collection of photographs, drawings, movies, and sound bites to explore the many types and uses of fountains. Winner, ENC Digital Dozen (June 1996). [ENC-001896]

Nature, Science, and the Web
http://www.caosclub.org/nsw/index.html

The Education Department of the Chicago Academy of Sciences provides this Web site to highlight the Academy's activities for teachers and families. The site features information and products developed by the Academy's curriculum development division, as well as lessons and activities for environmental education, Web-based activities, and teacher education workshops. Resources about free science education materials are also provided. In a sample activity, visitors use a set of virtual tools to identify the source and composition of a mystery rock. Other projects include a student-developed Web page about animals and their habitats; a teacher's guide with lessons and activities to accompany the *New Explorers* television series; and a weekly, hands-on science program broadcast live via the Internet that provides activities that are correlated to state standards and benchmarks. In a sample activity, students investigate how the sugar in tree sap keeps trees from freezing during the winter. In addition to background information, procedures, and materials lists, the activity also contains interdisciplinary connections, suggested assessments, and Internet and bibliographic references. [ENC-0011584]

Ontario Science Centre (Centre des sciences de l'Ontario)
http://www.osc.on.ca/

This award-winning site is the home page of the Ontario Science Centre in Ontario, Canada. In addition to general information about the Science Centre, this site provides a schedule of exhibits, events, and educational programs and a collection of interactive online exhibits. In sample activities, users can mix subtractive and additive primary colors and experience audio and optical illusions through the verbal transformation effect and the Stroop effect. This site also provides a list of "Stupid Computer Tricks" that allow users to race their mice forward, backward, and sideways around a track, and visualize the pixels on their computer screens. Winner, ENC Digital Dozen (December 1996). [ENC-002275]

The Science Museum (London)
http://www.nmsi.ac.uk/welcome.html

Part of Britain's National Museum of Science and Industry, the Science Museum site informs visitors about the museum's current exhibits and collections, research projects, and educational resources. In the "Online Activities" section, users can participate in virtual experiments on the brain and vision, travel on a virtual tour of the museum, and see pictures and descriptions of exhibits. Sample exhibits include "The Challenge of Materials," which discusses how things are made and how certain materials have influenced the world. A new addition to the page is an online exhibition on flight, including the history of flight as well as photographs and technical information on planes and engines. Links provide educators with information on how to order books, pamphlets, and resource packs from the museum. Winner, ENC Digital Dozen (September 1996). [ENC-009300]

Thinking Fountain
http://www.sci.mus.mn.us/sln/tf/

Maintained by the Science Museum of Minnesota as part of the Science Learning Network (SLN), this site features thematic ideas and activities that offer surprising, gross, funny, and personal connections to science. Each Thinking Fountain activity highlights an interesting resource related to science, and then refers the user to three other connections that extend the learning process. It encourages questioning and inquiry by modeling the way questions about one thing lead to other topics and questions. Visitors can explore the theme highlighted on the home page, or they can choose from an alphabetical listing of themes. Each theme includes links to additional Web sites, reviews of related children's books, and a list of Activities That Make Me Think. Winner, ENC Digital Dozen (June 1996). [ENC-001895]

The Field Museum
http://www.fmnh.org/

The exhibits available at this Web site, maintained by the Field Museum in Chicago, include the "Life Over Time" exhibit and the "Javanese Masks" exhibit. The former begins by considering single-celled organisms that lived 3.8 billion years ago and concludes by describing the woolly mammoths that roamed the Earth 18,000 years ago. While on the tour, users may access information about several types of dinosaurs, the earliest mammals, and early human evolution. The second exhibit highlights traditional Indonesian masks in the museum collection. The Student/Teacher Programs link provides information to help community educators, chaperones, and parents prepare for a school group visit to the museum. Also included is information on workshops and resources to help educators get their students to focus and learn from museum exhibits. [ENC-011166]

The Exploratorium

Science of Hockey
http://www.exploratorium.edu/hockey/

At this site, users can read about National Hockey League players and coaches from the San Jose Sharks, as well as physicists and chemists. The site is divided into seven sections, the first of which discusses ice and several of the qualities that make ice a unique playing surface. Players and scientists discuss differences between "fast ice" and "slow ice" and a chemist explains why ice is slippery. The second section investigates the mechanics of skating on ice, while the the third section describes technological advances in hockey equipment such as carbon-graphite sticks, aluminum shafts, and fiberglass/kevlar goalie masks. The fourth section deals with the reaction time and reflexes of NHL goalies. The Shooting section explains how hockey players are able to shoot the puck more than 100 miles per hour. Mathematical formulas are used to show how much force is generated during a check between two players. The final section talks about physical fitness, nutrition, and the chemistry of lactic acid production. Winner, ENC Digital Dozen (July 1997). [ENC-009882]

Cow's Eye Dissection
http://www.exploratorium.edu/learning_studio/cow_eye/index.html

Part of the Science Learning Network, this site simulates, in a step-by-step fashion, the experience of a laboratory dissection. From the home page, users may access and view a dissection of a cow's eye, receive hints and tips from student Explainers who have previously performed other dissections, and review a primer that provides more information on the various parts of the eye. Links are available to other eye data sites, such as one that features vision science facts, and to a biological supply house where cow eyes and other supplies may be ordered. Winner, ENC Digital Dozen (April 1997). [ENC-009314]

Franklin Institute Science Museum

The Heart: A Virtual Exploration
http://www.fi.edu/biosci/heart.html

This Web site illustrates the heart and the complexities of its development and structure. Provided are descriptions of blood and blood vessels and of body systems such as circulatory, pulmonary, and excretory systems. The site also discusses how to monitor a heart's health using echocardiography and electrocardiography. Visitors can learn about the history of heart science, the importance of exercise and diet, and the different heart diseases. Included also are links to other Web sites that provide related resources and activities. Winner, ENC Digital Dozen (September 1995). [ENC-003907]

Passport to Africa
http://www.fi.edu/tfi/info/current/africa/africa.html

Based on the Africa exhibit at the Franklin Institute, which ran from February to May, 96, this Web site describes the culture, geography, science, and politics of the African continent. Real-life settings, hands-on activities, multimedia presentations, and African artifacts illuminate present West, Central, East and North Africa, and the African Diaspora during various historical periods. The Itinerary page allows the user to examine the geography, culture, history, and language of many African countries, including Benin, Cameroon, Zaire, and Kenya. Users may also access maps, art exhibits, and the Ethnologue, a catalog of the world's languages. Winner, ENC Digital Dozen (September 1996). [ENC-002159]

The Philadelphia Inquirer's Health & Science Magazine
http://www.fi.edu/inquirer/inquirer.html

This site offers enhanced reprints of feature stories from a weekly section of *The Philadelphia Inquirer* that covers current topics in science and medicine. Background information, teacher resources, multimedia, and interactivity are added to the articles, providing a continually changing source of science news for classroom use. Sample topics include: studies of the fruit fly to discover the link between human behavior and genes; the genetics of diabetes; the environmental impact of a hydrogen powered car; and the use of computer mating by zoos to propagate endangered species. Each article contains links to additional Internet sites for supplemental teacher resources and student activities. Winner, ENC Digital Dozen (November 1995). [ENC-004062]

Theater of Electricity
http://www.mos.org/sln/toe/toe.html

This site, maintained by the Boston Museum of Science, explores the topic of electricity as it applies to Van de Graaff generators, Tesla coils, and lightning. Directions are provided for many simple experiments involving static electricity, such as making a simple electroscope and determining which objects will be attracted by charged balloons. The history and use of the Van de Graaff generator are explored using pictures, film clips, and text. Lightning and Benjamin Franklin's kite experiment are discussed, followed by a tutorial on how lightning forms and what makes a car a safe place to be during a lightning storm. [ENC-009327]

Pacific Science Center
http://www.pacsci.org/default.html

Seattle's Pacific Science Center provides this Web site to inform users of the museum's many programs for schools and families. Online exhibits can be viewed on topics such as raptors, bats, and nutrition. The nutrition exhibit provides three online games and quizzes. Teacher materials describe workshops that are offered by the museum, provide background material on some exhibit topics, and include classroom activities such as a word scramble of musical terms and a multidisciplinary lesson on constellations. Hints are provided on how to involve parents and the community in school science programs. [ENC-011345]

Section VI: Youth Organizations

Partners for Learning:
Interview with Carolyn Kennedy

Julia L. Harris
ENC Publishing Group

Carolyn Kennedy, Director of Special Projects with the Girl Scouts of the U.S.A. (GSUSA), has been with the organization for more than 20 years and was a Girl Scout herself. When asked to describe the benefits to girls who participate, she says, "Part of the program is allowing children to make choices for themselves about what they want to do and how they want to do it." The social aspect is also an important one: girls who participate in the program are doing so with friends, and as Kennedy notes, "Girls in particular learn a great deal through interacting with peers their own ages."

GSUSA has served girls for more than 86 years and has more than 3.5 million members, 800,000 of whom are adults. It is, in fact, the largest organization of its kind for girls in the world.

The fact that the Girl Scouts is an all-girl program plays a significant part in making the experience a valuable one for the participants, Kennedy asserts. In the science and sports programs in particular, she believes that girls feel more comfortable taking initiative and leadership roles than they would in a mixed gender environment.

As girls grow up in the program—starting with Daisy Girl Scouts for kindergartners and progressing through Senior Girl Scouts for high school girls—they are encouraged to become active participants in their own learning, taking ownership of and responsibility for their personal growth. Through the Girl Scout system of "recognitions," girls' achievements are acknowledged and rewarded, giving them increasing motivation to succeed.

Leaders as Learners

An innovative partnership between Girl Scouts of the U.S.A., The Franklin Institute, and science centers and Girl Scout councils across the country is designed to make achieving some of those recognitions even more exciting for girls. Funded largely by the National Science Foundation (NSF), the National Science Partnership for Girl Scouts and Science Museums (NSP) was launched in 1992 to address concerns of science literacy for girls. The program, led by GSUSA and The Franklin Institute Science Museum in Philadelphia, pairs local Girl Scout councils with area science centers, museums, or even colleges and universities, to provide the leaders with the training they need and familiarize them with science concepts and resources.

© Girl Scouts U.S.A.

Girl Scouts as partners in hands-on science exploration.

"We recognized that although Girl Scout troops love to come to science museums, the leaders themselves did not feel very comfortable about doing science with the girls," Kennedy explains. Using hands-on science activities and materials created to meet the science recognition requirements, the program provides training and kits for leaders that include all the materials they need to do the activities with their girls. NSP's four primary goals are to foster girls' interest in science, increase the skill and comfort level of Girl Scout leaders with science, develop alliances between Girl Scout councils and science centers, and disseminate information about the project.

Measures of Success

One of the great strengths of the program, which has been used as a model project by the NSF, is that it takes girls through the processes of science: observing, wondering,

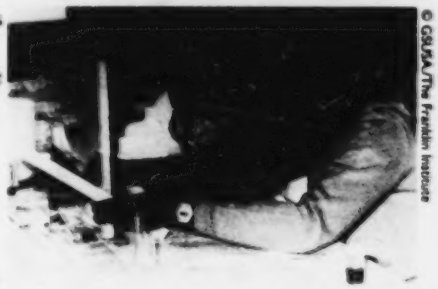
and hypothesizing, as well as encouraging them to reflect on the activities that career scientists do on a regular basis. "One of the activities we have girls do before they even start one of the kits is to draw a picture of a scientist. And most girls draw a white male, somewhat awkward in appearance, wearing a white lab coat in a lab full of strange liquids," Kennedy says with a laugh. "But at the end of the project, when we have the girls do the same activity, they often end up drawing people who look more like themselves."

When NSP first started, it was piloted by six Girl Scout councils and six science centers across the country. Now, there are more than 75 Girl Scout councils and science institutions involved. In the last six years, more than 140,000 girls have been involved and 12,000 Girl Scout leaders have been trained. Each participating community has a cadre of trainers who subsequently go on to train others, and often girls who have been through the program return to the partner science institution for more hands-on experiences.

© GSUSA/The Franklin Institute

Helping leaders become comfortable with science.

"Sometimes they do sleep-overs at the museum, or participate in career-awareness programs where they meet with someone at the museum who has a science-related career," says Kennedy.



© GSUSA/The Franklin Institute

Innovative science activities foster girls' excitement about science.

NSP is an active embodiment of one of the Girl Scouts' major objectives in working with girls, and that is to provide them with firsthand experience and interaction with the real world. Because of its strong community involvement component, NSP draws girls out of the insular world of the classroom and opens them up to a broader range of experiences and possibilities. "Many children think they know all about our environment because they've seen it on television—or at least they think they do!" says Kennedy. "Girl Scouting provides opportunities for girls to get out into the community and see what really occurs."

Supplemental Web Resources

Welcome to the Information Dirt Road: The 4-H Farm at the University of California, Irvine

http://www.ics.uci.edu/~pazzani/4H/InfoDirtRoad.html

Designed by the Computer Science project of the Irvine Mesa Charros 4-H Club, this Web site presents student projects in computer science and animal husbandry. The Information Dirt Road leads to the 4-H Farm at UC Irvine, a cooperative that allows children to learn to raise farm animals. Many of the projects describe the care, breeding, and showmanship of a variety of domestic farm animals. Other projects explore food and nutrition, marine biology, and local wildlife. For example, the goat project contains images and detailed descriptions about species of dairy and pygmy goats. Additional topics include general information about 4-H and the Orange County Fair, directions to the farm, rules for visitors, and links to animal related sites in the Web. This site was chosen to be among Point Communications' Top 5% of all Web sites. [ENC-011585]

KinderGarden

http://aggie-horticulture.tamu.edu/kinder/index.html

This award-winning Web site—Magellan 3-Star Site and Bonus.Com's Editor's Choice Award—for grades K–6 presents materials about gardening in schools. A step-by-step guide to starting a school garden is featured, along with a list of garden themes like an herb garden or a fiber garden. A checklist gives special considerations for starting a school garden, and a list of teacher resources and gardening books for children is also provided. For schools that do not have the resources for an outdoor garden, information is provided on developing an indoor growing science center. Activity ideas include making flower prints, constructing a special planting box for viewing root growth, and planting your state's grass or flower. Links are provided to botanical gardens and other gardening activities. Winner, ENC Digital Dozen (January 1998). [ENC-011163]

Science in the Worlds

Grades 4–6

1992

Distributor

The Franklin Institute
222 North 20th Street
Philadelphia, PA 19103-1194
Telephone: (215) 448-1153
http://www.fi.edu/

1 guide (Leaders): ISBN 0-9625622-2-X **$20.75**
Note: This publication is available only in conjunction with The National Science Partnership for Girl Scouts and Science Museums workshops. Contact The Franklin Institute for further information.

Author

The National Science Partnership for Girl Scouts and Science Museums; Girl Scouts of the U.S.A.; The Franklin Institute

Funding

National Science Foundation (NSF); American Honda Foundation; Annenberg Foundation; Equitable Foundation

Part of a series of activity kits by the National Science Partnership for Girl Scouts and Science Museums (NSP), this book helps girls learn how science is used in daily life. The NSP program, led by The Franklin Institute and Girl Scouts of the U.S.A., provides hands-on science activity kits and training workshops for Girl Scout leaders, helping them conduct science activities that are directly linked to the Girl Scout recognition requirements for Brownie and Junior Girl Scouts. Each book in the series offers a sequence of activities designed to be completed during troop meetings over the course of five to seven weeks. This book presents several examples of applied science in the worlds of medicine, art, and careers. In sample activities, the girls test a variety of foods for the presence of fat, use a prism to create a light sculpture, and interview a woman scientist. They also conduct experiments to show that the pressure created by sprouting seeds is enough to crack a plastic vial. In other activities, the girls go on a "geowalk" to look for signs of erosion and keep a journal of the ways in which they use science themselves. For each activity, the book provides a list of materials, background information, advance preparation instructions for leaders, technical hints, and extension activities. Bibliographic references and reproducible worksheets are also included. (Author/LCT) [ENC-011778]

Related Resources

ENC has other materials from the National Science Partnership for Girl Scouts and Science Museums, including:

Science Wonders (1991)
Developed for grades 1–3, this book introduces girls to science as a process of discovery. It presents the concepts of fibers, crystals, magnets, and chemical changes. In sample activities, the girls draw a picture of a scientist and use the carbon dioxide gas produced by mixing baking soda and vinegar to blow up a balloon. [ENC-011776] (See above for contact information.) **$23.50**

Science Sleuth (1992)
Girls in grades 4–6 are introduced to the detective work of science through a series of physical science activities. This kit presents the concepts of matter (solids, liquids, and gases), crystals, chromatography, and sound. In sample activities, the girls explore non-Newtonian fluids by examining a sticky, green substance made of cornstarch, use filter paper and Epsom salts to make crystal snowflakes, and invent their own Rube Goldberg devices. [ENC-011777] (See above for contact information.) **$27.00**

Outdoor Education in Girl Scouting

Grades K–12

1996

Publisher

Girl Scouts of the U.S.A.
420 Fifth Avenue
New York, NY 10018-2798
Toll-free: (800) 221-6707
Telephone: (212) 852-8000
Fax: (800) 643-0639
E-mail: admin@gsusa.org
http://www.girlscouts.org/

1 text: ISBN 0-88441-488-4; Order # 26411 **$9.50**

Author

Carolyn L. Kennedy; contributors, Maria L. Caban, Joan W. Fincutter, Sharon Woods Hussey, Harriet S. Mosatche, Donna L. Nye

As presented in this book, the goal of outdoor education is to allow opportunities to explore and develop an understanding of the outdoors and to find a comfortable relationship that works for each person. Toward that end, the book provides a compendium of information, teaching techniques, and activities for outdoor education. Outdoor education is defined as any outdoor activity through which people develop their outdoor recreational interests and skills. In the beginning of the book, information is provided on the use of questioning skills to guide the thinking process. Also covered are characteristics of outdoor activities and the different levels of outdoor activity or specific skills. Early chapters provide introductory activities such as mapping the neighborhood, examining the soil, and investigating the plants and animals in the local area. Specific chapters cover camping skills, safety in outdoor activities, and map and compass skills. Particular attention is given to the environment and the need for all outdoor activities to cause minimal impact. Environmental awareness is heightened through activities that deal with weather, soil, and ecosystems. Each chapter provides background information, specific instructions, and open-ended activity ideas. The appendices include a glossary, a list of resources, and typical equipment lists for camping. (SSD/Author) [ENC-011548]

Related Resources

Fun and Easy Nature and Science Investigations (1996)
Making use of local resources and inexpensive materials, the 10 activities in this book give K–12 students experience with nature and science topics such as insects, birds, and light. The introduction contains tips for using the activities, which are geared for both the indoors and outdoors. Also presented is a guide to questioning and using open- and closed-ended questions to stimulate thinking. Each activity includes a materials list, background information, procedure, and discussion questions. Students conduct their own scientific investigations, such as growing molds and surveying the neighborhood for pollution and garbage problems. [ENC-011547] (See above for contact information.) **$4.95**

WorldWise: A User's Guide for the Planet (1996)
Suitable for students of all ages, this environmental education manual presents a series of ecology units designed to introduce students to the concept of an ecosystem, competition, habitats, and energy cycles. Each unit offers activities in three learning formats: informational, project-based, and service learning. The project-based learning sections offer Project WILD activities as a tool to teach the concepts found in the unit. In sample activities, students learn about limiting factors by playing the role of bears in search of a habitat and create murals showing three major stages of pond succession. For each activity, the book summarizes learning objectives and provides background information, a list of materials, a step-by-step procedure, and extension activities. Bibliographic and Internet resources are also provided. [ENC-011601] Camp Fire Boys and Girls, toll-free: (800) 669-6884 **$7.95**

The Estes Educator Guide for Teachers and Youth Group Leaders

Grades 5–12

1992

Publisher

Estes Industries, Inc.
1295 H Street
PO Box 227
Penrose, CO 81240-0227
Toll-free: (800) 820-0202
Telephone: (719) 372-6565
Fax: (800) 820-0203

1 booklet: part # 2814 **$2.40**

Designed for secondary teachers and youth group leaders, this booklet is an introduction to model rocketry. It describes some of the educational reasons for introducing model rocketry, explains the Estes educational program, and describes the Estes product line. Important facts about the model rocket engine are detailed, as well as safety features. A description is provided of the preparation and launch of a rocket, along with information concerning the laws and regulations pertaining to model rocketry. (SSD/Author) [ENC-011180]

Author

John Carroll

Related Resources

ENC has other materials that deal with model rocketry, including:

Experimenting with Model Rockets: Teacher's Guide (1991)

This series of teacher's guides, part of the *Great Explorations in Math and Science* (GEMS) materials, contains guided discovery activities that can be presented by teachers without special background in math or science. Intended for grades 6–10, these activities are intended to develop such skills as observation, measurement, experimentation, and recording data. Students experiment to see what factors influence how high a model rocket will fly by varying the number and placement of fins or the length of the body tube. Safety and teamwork are stressed. Extension and age modification suggestions are included, in addition to source lists for suggested materials, bibliographic references, and blackline masters. [ENC-002746] University of California, Berkeley (GEMS), telephone (510) 642-7771 **$16.00**

Ignite the Imagination (1997)

Developed for grades 5–8, this curriculum guide and accompanying educational video introduce the idea of using model rocketry in the classroom. The teacher's guide contains 13 lessons and activities about the physics of flight, basic rocket design, and careers in the aerospace industry. Additional topics include the space shuttle, microgravity, and remote sensing. In sample activities, students demonstrate how the forces and energy of a balloon relate to those of a rocket engine, assemble rockets that use various recovery systems, and build a model satellite out of common household items. [ENC-011549] (See above for contact information.) **$11.15**

Earth Matters: A Challenge for Environmental Action

Grades 1 - 12

1990

Publisher

Girl Scouts of the U.S.A.
420 Fifth Avenue
New York, NY 10018-2798
Toll-free: (800) 221-6707
Telephone: (212) 852-8000
Fax: (800) 643-0639
E-mail: admin@gsusa.org
http://www.girlscouts.org

1 text: Order # 26070 **$2.50**

Author

Carolyn L. Kennedy, Patricia J. Dreier, Chris Bergerson, Donna L. Nye

Series: Contemporary Issues

Part of the Girl Scouts' *Contemporary Issues Series*, this environmental education resource book was developed to empower girls and adults to take action to protect the environment. The book provides a series of starter activities and ideas for shaping short- or long-term environmental action projects in the community. The first chapter provides an overview of environmental issues, while subsequent chapters focus on interrelationships in the environment, value systems that include caring for the Earth, and sustainable development. Also explained is how girls can earn the "Earth Matters" patch by doing an environmental action project. In sample activities, the girls develop a family recycling plan and interview elderly relatives or friends to learn how they used energy in their homes when they were children. The girls also discuss a series of dilemmas that have environmental implications. A glossary, resources, and bibliographic references are included. (Author/LCT) [ENC-011586]

A Patch of Eden: America's Inner-City Gardeners

Grade 5 & Up

1996

Publisher

Chelsea Green Publishing Company
PO Box 428
White River Junction, VT 05001
Toll-free: (800) 639-4099
Fax: (802) 295-6444

1 text: ISBN 0-930031-80-6 **$18.95**

Author

H. Patricia Hynes

This book highlights and describes urban community garden projects in Harlem, North Philadelphia, Chicago, and San Francisco. The stories feature expert gardeners who work with children, elders, immigrants, inmates, and low-income people to create both food and flower gardens in their own neighborhoods. The Chicago Cabrini Greens, named for a Chicago public housing project, produces a half-acre tomato, pepper, and gourmet mixed lettuce garden. Volunteers, all of whom are children from the housing project, sell the crops to Chicago restaurants and share in the profits. Another project, the Greening of Harlem, includes 17 gardens that were built, designed, and tended by neighborhood people and community institutions. Color and black-and-white photos illustrate the gardens and lifestyles of the communities involved in each project. The book includes a list of community gardening organizations and information for communities interested in starting a garden project. (Author/FEB) [ENC-002091]

To Build a Trail: Enhancing America's Pathways

Grades 7–12

1994

Publisher

National 4-H Council
PO Box 79126
Baltimore, MD 21279-0126
Telephone: (301) 961-2934
Fax: (301) 961-2937
E-mail: 4hsupply@fourhcouncil.edu
http://www.fourhcouncil.edu/

1 video and reference guide: Order # ES0008
$5.00

Author

Writing team, Bob Bash, Lisa Connelly, Mike Dolfay, David Gorin, Susan Halbert, Bobbi Lipka, Eric Lundquist, Jim Williams; a project of the National Land Use Collaboration, arranged by the National 4-H Council

Funding

American Honda Motor Company, Inc.

Series: On Common Ground

The *On Common Ground* series, sponsored by the Environmental Stewardship Program of the National 4-H Council, is designed to further young people's understanding of key environmental issues through critical-thinking and decision-making exercises. This video and accompanying trail planning guide focus on what is involved in building a trail and discuss points to consider, such as why the project is needed, who the project will serve, and how individuals, groups, and agencies will be involved. Also highlighted are landowner relations, design standards, legal considerations, and long-term maintenance of the trail. Information is provided about each planning stage in the trail project, including project identification, feasibility and survey, and design and construction. The video and guide also discuss key considerations such as entering and exiting the trail, parking capacity, and size and types of vehicles permitted. Another important factor to consider is the trail's proximity to neighborhoods, campgrounds, and commercial facilities. Also needed are maps, a signing plan, and ongoing maintenance of the trail. The planning guide contains trail acronyms, organizations, and manuals. The authors also provide references and a suggested format for introducing the video in a group setting. (Author/DJS) [ENC-010473]

Recreational Trails

Grades 5–9

1995

Publisher

National 4-H Council
PO Box 79126
Baltimore, MD 21279-0126
Telephone: (301) 961-2934
Fax: (301) 961-2937
E-mail: 4hsupply@fourhcouncil.edu
http://www.fourhcouncil.edu/

1 curriculum set (leader guide/poster): Order # ES0028 ***$1.25***

Author

A project of the National Land Use Collaboration, arranged by the National 4-H Council; writing, Mary Kroll, Kroll Communications; illustrations, John Burgoyne

Funding

American Honda Motor Company, Inc.

Series: On Common Ground

Created for middle school students as part of the *On Common Ground* series of the National 4-H Council, this activity book focuses on recreational trails. In the first activity, students decide whether or not to support the construction of a trail in a fictional area. The second activity asks students to search for a location for a new trail, then plan the project. In the third activity, students decide whether to support various recreational uses of a fictitious trail and use conflict management skills to attempt to reach a resolution. For the fourth activity, students decide whether trail use can damage an area. Information to help teachers to prepare for the activities (such as lists of needed resources and discussion of safety concerns) is supplied at the beginning of the book. Procedure and presentation tips are provided for each activity. This book contains a resource list, and the accompanying recreational trails poster presents a timeline, reasons to be concerned about recreational trails, and some issues surrounding them. (Author/DJS) [ENC-10474]

Mud, Muck, and Other Wonderful Things: An Environmental Curriculum

Grades K–3

1995

Series: Environmental Stewardship

Publisher

National 4-H Council
PO Box 79126
Baltimore, MD 21279-0126
Telephone: (301) 961-2934
Fax: (301) 961-2937
E-mail: 4hsupply@fourhcouncil.edu
http://www.fourhcouncil.edu/

1 text Order # ES1007 **$6.00**

Author

Writer, Mary Kroll, Kroll Communications; illustrator, Nancie McCormish; a product of the National 4-H Council in cooperation with the Cooperative Extension System and the curriculum review team

Funding

John Deere Foundation

This book on environmental education covers topics such as ecosystems and habitats, water cycles and energy flow through a system, and the differences between biotic and abiotic environmental factors. Each of its seven chapters begins with a section that provides a basic understanding of the featured topic and explains how much young children can be expected to understand about it, based on their developmental stage. For each activity, readers are given information on the specific life skills it emphasizes, appropriate group size, materials needed, and duration. A section entitled "Being a steward for the environment means..." follows each activity; this section is intended to be read to the children by the teacher or leader. Sample activities include making food chains and food webs, matching organisms with their habitats, and investigating how seeds move from one location to another. A chart summarizes the characteristics and capabilities of five- to eight-year-olds and the implications for successful program delivery. A second chart outlines outcomes, as well as appropriate locations and time of year, for each activity. (Author/DJS) [ENC-010477]

Outer Spaces: Discovering the Explorer in Me

Grades 5–10

1991

Series: Spaces: Preparing Kids for a High-Tech and Global Future

Distributor

MSU Bulletin
10B Agriculture Hall
Michigan State University
East Lansing, MI 48824-1039
Fax: (517) 353-7168

1 kit Order # 4H1488 **$7.50**

Author

Michigan 4-H Youth Programs

This packet is part of *Spaces*, a Michigan 4-H program in which adults help kids gain the confidence and skills they need to be successful in the world of the future. Volunteers work with early adolescents in three major areas: science and technology (*Outer Space*), personal coping skills (*Inner Space*), and cultural, environmental, and communication skills issues (*Shared Space*). The *Outer Space* materials are organized into three key areas: "Discovering the Explorer in Me," "Discovering the Scientist in Me," and "Discovering the Inventor in Me." This packet, "Discovering the Explorer in Me," helps kids develop a sense of curiosity and wonder, face their fear of failure and the unknown, and create new paths. These concepts are demonstrated through 12 activities that include using questioning and team problem-solving skills to identify the contents of a "Mystery Bag"; assuming the role of interplanetary explorers and deciding how to react to the rules of the local culture on the planet Xandia; and creating exhibits for the 2025 World Fair that show how people are explorers in different career areas. The leader's guide provides a brief overview of the key concepts, activities and ideas for extensions, and a list of additional resources. (Author/LCT) [ENC-003773]

Financial Fitness

Grades 7–12

1993

Publisher

National Future Homemakers of America (FHA) HERO
Lock Box Operations
PO Box 630340
Baltimore, MD 21263-0340
Toll-free: (800) 234-4425
Telephone: (703) 476-4900
Fax: (703) 860-2713
http://www.fhahero.org/

1 booklet: Order # PB4 **$8.00**

Author

Future Homemakers of America, Inc. (FHA), FHA/HERO Chapters

Teenagers can use this booklet to learn how to become peer educators who help other teens sharpen their skills in money management, consumerism, and financial planning. Financial Fitness is a program developed and run by Future Homemakers of America (FHA/HERO), a national organization of young people using teen-to-teen communication. Reproducible workbook pages provide experience with doing a financial fitness checkup, identifying a concern, planning a project, and reporting about the project. In a sample project, students identify the problem of waste generated by grocery bags and form a company to make and sell reusable grocery bags. Each of the five recommended steps for project development are discussed in the grocery bags project: identify concerns, set goals, form a plan, act, and follow up. The "Fun Factor" section describes hands-on activities and games to help the peer educators to involve their audience. The booklet includes a list of resources and techniques for better communication and public relations. (Author/JRS) [ENC-011592]

Related Resources

ENC has other items in its collection that deal with the practical, real-world applications of math, including:

A Money Adventure: Earning, Saving, Spending, Sharing (1996)
The third in the *One and Only Common Sense [Cents] Series*, this unit provides 22 activities for K–3 students that deal with the concepts of operating a small business, covering aspects such as risk, profit and loss, and money transactions. Through the adventures of the GreenStreet$ Kids, children learn about money and explore principles of economics while they learn mathematics. Informal assessment is encouraged through the use of passbooks, personalized money-related notebooks in which children can write or draw their responses to an activity and collect important papers. In a sample activity, "More Ways Than One," children use problem-solving strategies to find coin combinations that make one dollar. [ENC-008004] Modern Curriculum Press, toll-free: (800) 321-3106 **$125.00**

Math on a Trip (1994)
Intended for upper elementary teachers, this book is one of a series of math-based, hands-on thematic units. Children apply math concepts and skills to home and school situations. The units include teacher resource pages, student forms for recording information, activity sheets, and patterns. This unit helps students see that math surrounds them on a family trip. A number of travel themes are explored, including "How will we get there?" and "How long will it take?" (Author/SXA) [ENC-007447] Evan-Moor Educational Publishers Co., toll-free: (800) 777-4362 **$6.45**

What's Equal? Figuring out What Works for Girls in Coed Settings

Grades Pre-K–12

1993

Publisher

Girls Inc.
441 West Michigan Street
Indianapolis, IN 46202
Telephone: (317) 634-7546
Fax: (317) 634-3024
http://www.girlsinc.org/

1 booklet: ***$15.00***
Note: Price includes shipping and handling.

Author

Principal author, Bernice Humphrey; contributing author, Debbie Zeluff

Funding

Dewitt Wallace Reader's Digest Fund

Developed for directors of youth organizations, this book is based on the proceedings of a symposium hosted by the Girls Incorporated National Resource Center to discuss issues on working with girls in coeducational settings. Girls Inc.—formerly Girl's Clubs of America—is a national youth organization dedicated developing research-based informal education programs that encourage girls to take risks and master physical, intellectual, and emotional challenges. Major programs address mathematics and science education, adolescent health issues, and media literacy. This book summarizes the end results of the symposium and provides guidelines for helping youth organizations level the playing field by focusing on girls. The authors provide a rationale for focusing on girls in coeducational organizations and provide questions to help participants assess how well their organizations meet the needs of girls. Also addressed are general programming considerations for increasing girls' participation in team sports and in leadership roles. Guidelines are provided for developing policies to achieve equity in sexuality, life planning, and conflict resolution issues. The book includes bibliographic references and a checklist for focusing on girls in coed settings. (Author/LCT) [ENC-011591]

Questions

Grades 1–12

1990

Publisher

Girls Inc.
441 West Michigan Street
Indianapolis, IN 46202
Telephone: (317) 634-7546
Fax: (317) 634-3024
http://www.girlsinc.org/

1 video: ***$20.00***
Note: Price does not include shipping and handling.

Author

Girls, Inc.

Operation S.M.A.R.T. (Science Math & Relevant Technology) is an educational program offered by Girls Inc. that is designed to promote achievement in girls ages 6–18. The video begins by showing a young participant in the program working on her bicycle. Fundamental issues and academic goals of Girls Inc. are then defined and discussed, including the importance of mathematics and science skills in developing career options that pay well and offer advancement and personal fulfillment. Also discussed is the necessity of encouraging scientific and mathematical literacy in the national labor pool of both men and women to enable the United States to maintain its international competitiveness. The program emphasizes the importance of encouraging girls to be curious, find answers for themselves, explore, and take risks. Activities include field trips to visit adult female volunteers who provide onsite overviews of the work they are doing. The program is sponsored by the National Science Foundation and many other major corporations, foundations, and museums throughout the United States. Girls Inc. also offers several other programs including *Choices*, an introduction to life management skills including decision making, career options, and adolescent pregnancy prevention; and *Sporting Chance*, which focuses on physical fitness, developing competitiveness, and team playing skills. (WAJ) [ENC-000233]

enc Demonstration Sites

Appalachian Region

Kentucky, Tennessee, Virginia, West Virginia

Ray Ramquist
Educational Media Labs
James Madison University
MSC 1905
Roop Hall
Harrisonburg, VA 22807
Phone: (540) 568-6302
Fax: (540) 568-3780
E-mail: ramquirc@jmu.edu

Mid-Atlantic Region

Delaware, Washington, D.C., Maryland, New Jersey, Pennsylvania

Pete Donahoe
Mid-Atlantic Consortium for Mathematics and Science Education
444 North Third Street
Philadelphia, PA 19123-4107
Phone: (215) 574-9300 ext. 277
Fax: (215) 574-0133
E-mail: donahoe@rbs.org

Far West Region

Arizona, California, Nevada, Utah

Anne Malley
Biodiversity Resource Center
California Academy of Sciences
Golden Gate Park
San Francisco, CA 94118
Phone: (415) 750-7361
Fax: (415) 750-7106
E-mail: amalley@cas.calacademy.org

North Central Region

Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Wisconsin

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Fermi National Accelerator Laboratory
Lederman Science Education Center
PO Box 500, MS 777
Batavia, IL 60510-0500
Phone: (630) 840-3094
Fax: (630) 840-2500
E-mail: sdahl@fnal.gov

Mid-continent Region

Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, Wyoming

Jeff Johnson
Eisenhower High Plains Consortium for Mathematics and Science
2550 South Parker Road, Suite 500
Aurora, CO 80014
Phone: (303) 337-0990
Fax: (303) 337-3005
Toll-free: (800) 949-6387
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Northeast and Islands Region

Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont, Puerto Rico, Virgin Islands

Molly Singsen
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Northwest Region

Alaska, Idaho, Montana, Oregon, Washington

Kristen McCowan
Information Science Hall
Oregon Museum of Science and Industry
1945 SE Water Avenue
Portland, OR 97214-3354
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Fax: (503) 797-4568
E-mail: kam@omsi.edu

Southeastern Region

Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina

Ed Anderson
Science & Technology Museum of Atlanta (SciTrek)
PO Box 54244
Atlanta, GA 30308
Phone: (404) 589-8008
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E-mail: edanderson@mindspring.com

Pacific Region

American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Hawaii, Republic of the Marshall Islands, Republic of Palau

Alice Borja
Pacific Mathematics and Science Regional Consortium
1099 Alakea Street, Suite 2500
Honolulu, HI 96813
Phone: (808) 533-6000 ext. 133
Fax: (808) 533-7599
E-mail: borjaa@prel.hawaii.edu

Capital Collection & Demonstration Site

Washington, DC

Shirley DeLaney:
The George Washington University
Instructional Media & Materials Center
Gelman Library, Room B06
2130 H Street, N.W.
Washington, DC 20052
Phone: (202) 994-7048
Fax: (202) 994-4520
E-mail: enc@gwis2.circ.gwu.edu

Southwestern Region

Arkansas, Louisiana, New Mexico, Oklahoma, Texas

Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST/SEDL)
211 East Seventh Street
Austin, TX 78701-3281
Phone: (512) 476-6861
Fax: (512) 476-2286

Eisenhower National Clearinghouse for Mathematics and Science Education

Columbus, Ohio

Eisenhower National Clearinghouse for Mathematics and Science Education

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Fax: (614) 292-2066
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Directory of Eisenhower Mathematics and Science Regional Consortia

Appalachia Region

Eisenhower Regional Math/Science Consortium at AEL
1700 North Moore Street, Suite 1275
Arlington, VA 22209
Phone: (800) 624-9120
http://www.ael.org/eisen/
States Served: Kentucky, Tennessee, Virginia, West Virginia

Far West Region

WestEd Eisenhower Regional Consortium for Science and Mathematics Education
730 Harrison Street
San Francisco, CA 94107-1242
Phone: (415) 241-2730 / Fax: (415) 241-2746
http://www.wested.org/werc/
States Served: Arizona, California, Nevada, Utah

Mid-Atlantic Region

Mid-Atlantic Eisenhower Consortium for Mathematics and Science Education
Research for Better Schools
444 North Third Street
Philadelphia, PA 19123
Phone: (215) 574-9300 / Fax: (215) 574-0133
http://www.rbs.org/eisenhower
States Served: Delaware, Washington DC, Maryland, New Jersey, Pennsylvania

Mid-continent Region

Eisenhower High Plains Consortium for Mathematics and Science
2550 South Parker Road, Suite 500
Aurora, CO 80014
Phone: (303) 743-0990 / Fax: (303) 337-3005
Toll-free: (800) 949-6387
http://www.mcrel.org/hpc
States Served: Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, Wyoming

North Central Region

Midwest Consortium for Mathematics and Science Education
1900 Spring Road, Suite 300
Oak Brook, IL 60521-1480
Phone: (630) 571-4700 / Fax: (630) 571-4716
http://www.ncrel.org/msc/msc.htm
States Served: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Wisconsin

Northeast and Islands Region

Eisenhower Regional Alliance for Mathematics and Science Education Reform
TERC
2067 Massachusetts Avenue
Cambridge, MA 02140
Phone: (617) 547-0430 / Fax: (617) 349-3535
http://www.ra.terc.edu
States / Areas Served: Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont, Puerto Rico, Virgin Islands

Northwest Region

Science and Mathematics Consortium for Northwest Schools
Columbia Education Center
171 NE 102nd Avenue
Portland, OR 97220-4169
Phone: (503) 252-4999 / Fax: (503) 252-4866
http://www.col-ed.org/smcnws/
States Served: Alaska, Idaho, Montana, Oregon, Washington

Pacific Region

Pacific Mathematics and Science Regional Consortium
Pacific Resources for Education and Learning
1099 Alakea Street, Suite 2500
Honolulu, HI 96813
Phone: (808) 533-6000 / Fax: (808) 533-7599
http://prel.hawaii.edu/math-science/
States / Areas Served: American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia (Chuuk, Kosrae, Pohnpei, Yap), Guam, Hawaii, Republic of the Marshall Islands, Republic of Palau

Southeast Region

Eisenhower Consortium for Mathematics and Science Education at SERVE
345 South Magnolia Drive, Suite E-22
Tallahassee, FL 32301
Phone: (850) 671-6033 / Fax: (850) 671-6010
http://www.serve.org/Eisenhower/
States Served: Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina

Southwest Region

Southwest Consortium for the Improvement of Mathematics and Science Teaching
211 East Seventh Street
Austin, TX 78701-3281
Phone: (512) 476-6861 / Fax: (512) 476-2286
http://www.sedl.org/sedl/scimast.html
States Served: Arkansas, Louisiana, New Mexico, Oklahoma, Texas

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Please share this publication with all math and science educators!

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